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Hugh Cecil Earl of Lonsdale.

1867. 1878 error see pref

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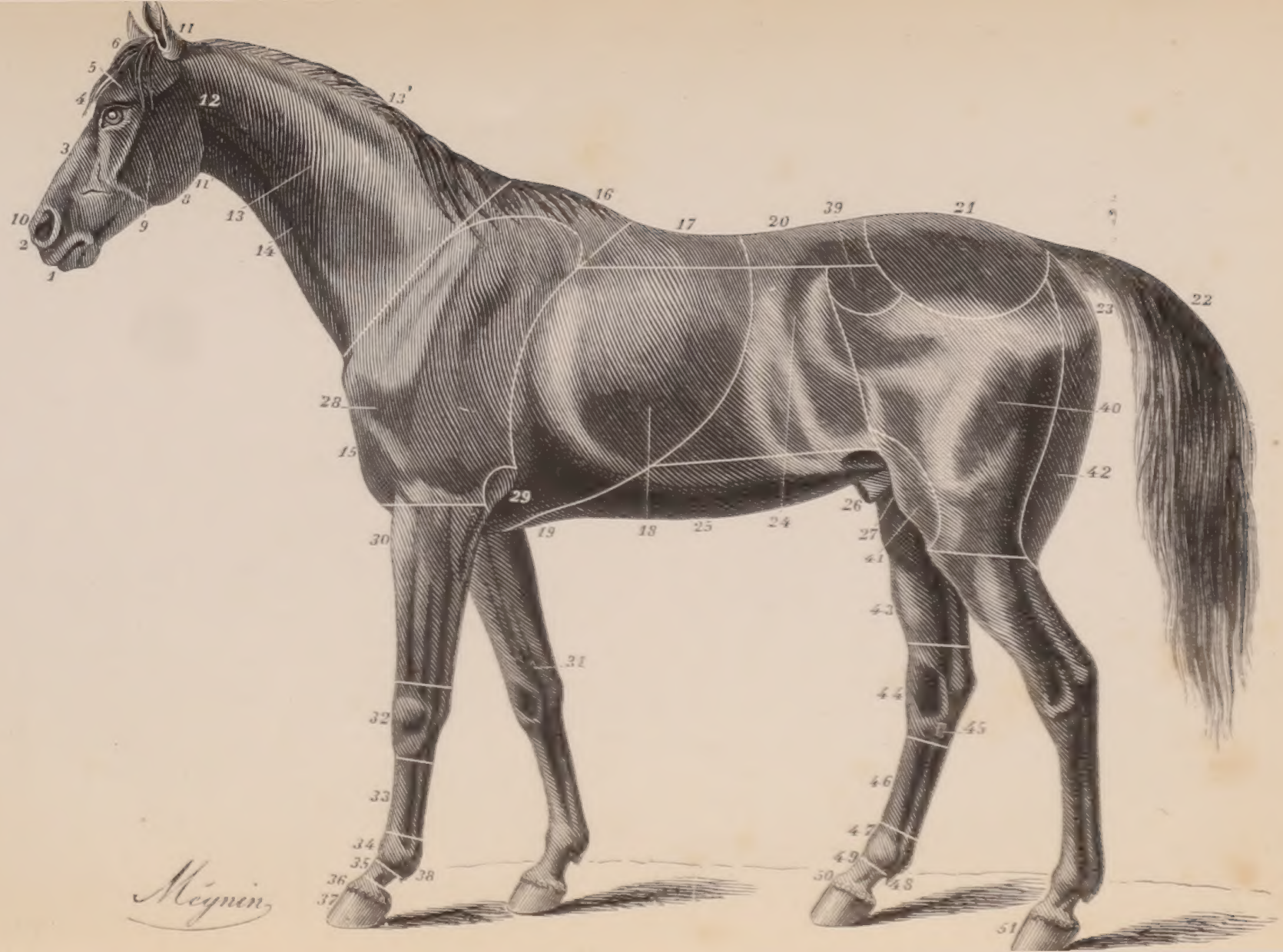
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EXTERNAL REGIONS OF THE HORSE.

1. Lips.
2. Nose.
3. Face.
4. Forehead.
5. Eyebrows.
6. Forelock.
7. Ears.
8. Lower jaw.
9. Cheek.
10. Nostril.
11. Poll.
11*a*. Throat.
12. Parotid.
13. Neck.
14. Jugular channel or furrow.
14*a*. Mane.
15. Chest.
16. Withers.
17. Back.
18. Ribs.
19. Girth.
20. Loins.
21. Croup.
22. Tail.
23. Anus (or "dock.")
24. Flank.
25. Belly.
26. Sheath.
27. Testicles.
28. Shoulder and arm.
29. Elbow.
30. Fore-arm.
31. Chestnut.
32. Knee.
33. Canon or shank.
34. Fetlock-joint.
35. Pastern.
36. Coronet.
37. Foot.
38. Ergot and fetlock.
39. Haunch.
40. Thigh.
41. Stifle.
42. Buttock.
43. Leg.
44. Hock.
45. Chestnut.
46. Canon or shank.
47. Fetlock-joint.
48. Ergot and fetlock.
49. Pastern.
50. Coronet.
51. Foot.

ANATOMICAL OUTLINES OF THE HORSE.

BY

J. A. McBRIDE, Ph.D., M.R.C.V.S.,

Director of the Veterinary Department in the Royal Agricultural College, Japan, and late Veterinary Professor at the Agricultural College, Cirencester.

SECOND EDITION.

REVISED AND ENLARGED, BY

T. WALTON MAYER,

Fellow, and Member of the Board of Examiners, R.C.V.S., and Veterinary Professor at the Agricultural College, Cirencester.

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PREFACE.

IN preparing this treatise on the Anatomy of the Horse, the Author has intended to assist in supplying a want which he has long felt in the course of his professional labours. It is possible that some may question whether, confining itself to a simple exposition of the more general features of the organization of that animal, this book will be of any important service to those who are engaged in the study of Veterinary Medicine. The writer, however, intends it to serve more as a Text Book for the students of his own class than as an anatomical treatise for general use. Its contents will be constantly amplified and illustrated by the lectures; and it may, therefore, be obtained interleaved, so that the student will have the opportunity of making his own notes and thus extending the information it contains.

If it should aid, even in a small degree, the study of Veterinary Anatomy, the Author will be sufficiently repaid for the labour he has bestowed upon its production.

J. A. McB.

The Agricultural College,
March, 1867.

PREFACE TO THE SECOND EDITION.

WHEN the former edition of this work was presented to the Veterinary Profession, Dr. McBRIDE stated that he had two purposes to serve—to assist those engaged in the study of Veterinary Medicine, and to provide a Text Book for the students of the Anatomical Class, at the Agricultural College, Cirencester. In this Revised Edition I have endeavoured to more fully realize these objects.

The professional student of Veterinary Anatomy will find the work of great utility in the dissecting room; while the Agricultural student will, by the use of the Plates, Glossary, and Index, added to this Edition, be greatly assisted in his class, and be enabled to follow the lecturer without difficulty, thus obtaining a practical knowledge of the Outlines of Equine Anatomy.

The acknowledgments of the editor are offered to the following authors who have already contributed to the advancement of physiological and anatomical science, viz.:— Dr. MAPOTHER; CHARLES STEEL, 16th Lancers; and JOHN HENRY STEEL, Demonstrator of Anatomy at the Royal Veterinary College, whose works contain much valuable information.

T. W. M.

Cirencester, August, 1878.

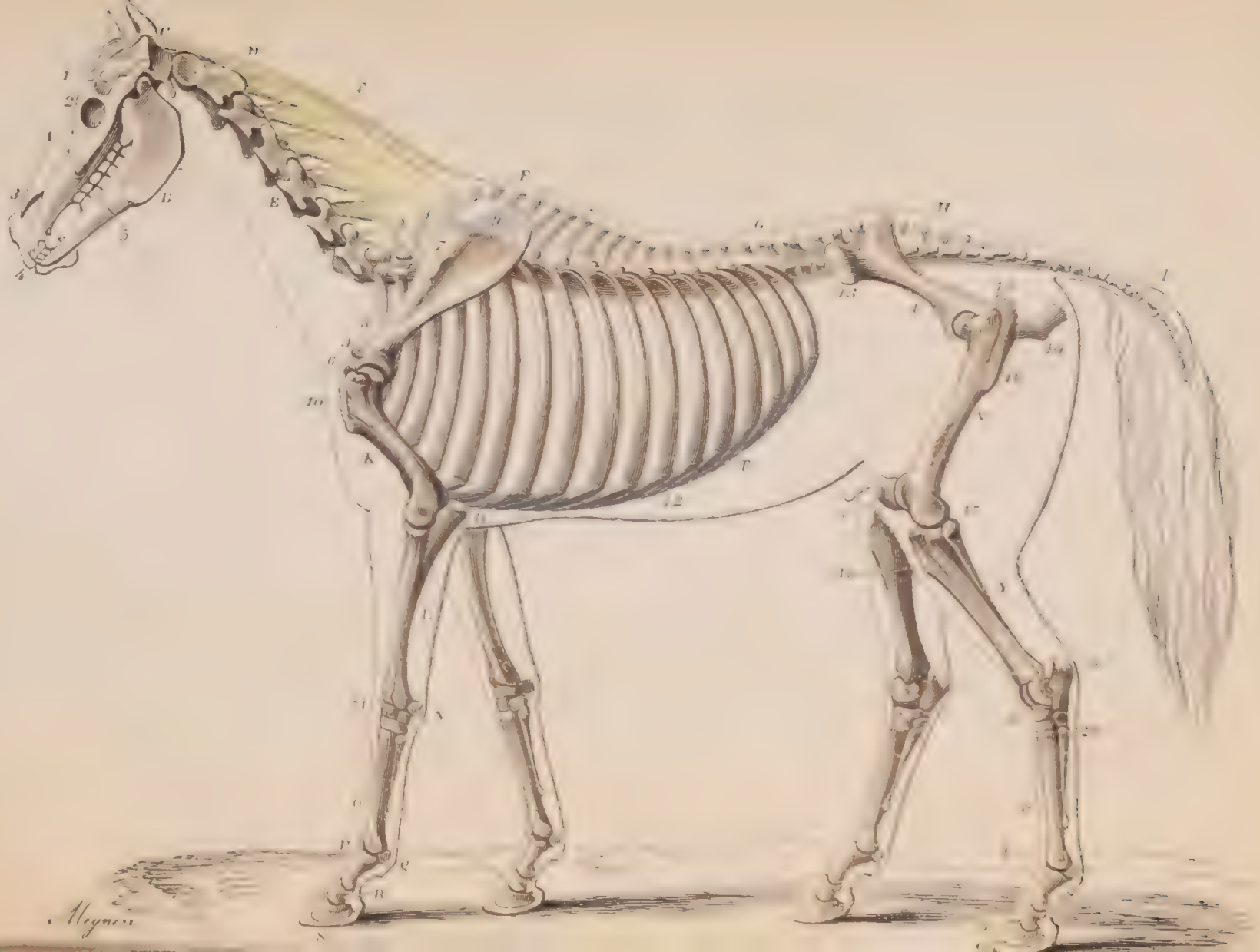

PLATE 1.–SKELETON OF THE HORSE.

A. Head.
B. Lower Jaw.
C. Atlas, or 1st vertebra of neck.
D. Axis, or 2nd vertebra of neck.
E. The remaining five cervical vertebræ.
F. Spinous processes of the back or withers.
G. Dorsal and lumbar vertebræ.
H. Sacrum, base of the croup.
I. Coccygeal, or tail-bones.
J. Scapula, or shoulder-blade.
K. Humerus, or arm-bone.
L. Radius, or bone of the fore-arm.
M. Carpal, or knee-bones.
N. Trapezium.
O. Metacarpal, or canon-bone.
P. First phalanx, or pastern bone.
Q. Sesamoid bone.
R. Second phalanx, or os coronæ.
S. Third phalanx, or os pedis.
T. Ribs.
U. Os innominata, or haunch-bone.
V. Femur, or thigh-bone.
X. Patella.
Y. Tibia, or leg-bone.
Z. Hock, or tarsal bones.
a. Canon, or metatarsal-bone.
b. First phalanx, or pastern-bone.
c. Sesamoid.
d. Second phalanx, or coronet bone.
e. Third phalanx, or foot bone.
f. Superior band of the cervical ligament or ligamentum nuchæ.
1. Zygomatic arch.
2. Orbital cavity.
3. Nasal, or face bones.
4. Incisor teeth.
5. Molar teeth.
6. Scapulo-humeral, or shoulder and arm joint.
7. Acromion process, or spine of the scapula.
8. Hollow of the shoulder-blade.
9. Cartilage of shoulder-blade.
10. Superior tuberosity of the humerus.
11. Olecranon, or elbow-bone.
12. Cartilages of the ribs.
13. Haunch—external and anterior angle of the ilium.
14. Ischium—posterior angle of the ilium.
15. Great trochanter.
16. Small do.
17. Articulation between the femur and tibia.
18. Superior tuberosity of the tibia.
19. Os calcis.
20. Head of small metatarsal bone.

ANATOMICAL OUTLINES OF THE HORSE.

INTRODUCTORY.

The study of the Anatomical and Physiological Outlines of the Horse and other domesticated animals is one of great interest and importance; by it we are taught to investigate the structure and economy of the animal frame.

"Anatomy depicts dead bodies: Physiology investigates the functions of those that are living. The former examines the bones, muscles, viscera, and all the other parts of the animal body in a state of rest; the latter considers them in a state of action."

"They have been described under the heads of *solids* and *fluids*."

"The **solid parts** are *bones*, *cartilages*, *ligaments*, *muscles*, *tendons*, *membranes*, *nerves*, *arteries*, *veins*, *hair*, *hoof*, and *ducts*, or fine tubular vessels of various kinds. Of these solid parts the following compound organs consist:—the *brain*, the *lungs*, the *heart*, the *stomach*, the *liver*, the *spleen*, the various *glands*, the *kidneys*, the *intestines*, the *mesentery*, the *larynx*, and the *organs of sense*, the *eyes*, *ears*, *nose*, and *tongue*."

"The **fluid parts** are the *saliva*, *serum*, *chyle*, *blood*, *bile*, *milk*, *urine*, *pancreatic juice* and *aqueous humour of the eyes*."*

* The Christian Philosopher, by Dr. Dick.

"The science of Anatomy is, therefore, very extensive; it details the situation, form, and relative attachments of the various parts, and is called **Descriptive Anatomy.** It enters into a description of the structure and physical nature of the various tissues, apart from any consideration of the organs they compose. **(General Anatomy.)** It enters into the investigation of changes in the structure of organs by disease or from congenital malformation. **(Pathological Anatomy.)** It combines the examination of the organs of animals, to understand their respective functions in the healthy state. **(Physiological Anatomy.)** It embraces also the examination of the various organs, muscles, nerves, and blood-vessels, and their precise situation, connections with and relations to each other, and where they are most exposed to injury under all circumstances. **(Surgical Anatomy).**"*

* Mayne Medical Vocabulary.

OSTEOLOGY.

All external form is dependent upon an internal skeleton or basement structure. This consists of a number of definitely but diversely shaped masses of a hard white substance, composed of a mixture of earthy and animal matter, called *bone*.

Bones are therefore regarded as the prop-work or scaffolding on which the body is constructed. They bear the same relation to the animal system as the wood-work to a building. They give shape and firmness to the body. They support its various parts, and prevent it from sinking by its own weight. They serve as levers for the muscles to act upon, and to defend the brain, the heart, the lungs, and other vital parts from external injury.

This apparatus is called the **skeleton** *(see Plate* 1*)* ; the consideration of which is the first step to the study of Anatomy. **The skeleton** essentially consists of a chain of bones called the vertebral column, the segments of which move more or less upon each other, and are so modified in different regions of the body, as to form the instruments of progression in the one, and protecting cavities in the other. The bones which enter into the formation of this apparatus are of various forms and sizes according to the uses to which they are destined. They are divided into three classes :—*long*, *flat*, and *irregular*.

The **long bones** are situated in the limbs, and have each a shaft and two extremities. The shaft is hollowed out, forming a cavity called the *medullary canal*. Examples of this class :—the *humerus*, *radius*, *metacarpals*, *femur*, *and tibia*.

The **flat bones** form cavities such as the *cranium* and

pelvis. They are composed of two layers of compact bone with one of cancellated tissue intervening, called the *diploë*. Example of this class: the *scapula*, *frontal*, *parietal*, and *pelvic* bones.

The **irregular bones** are chiefly composed of cancellated tissue covered by a thin compact layer. Examples of this class:—the bones of the *knee*, *hock*, and *vertebral column*.

In the extremely young subject all the bones are cartilaginous, being elastic and pliable, but afterwards the deposit of earthy matter in their substance and by alteration in the arrangement of their component elements, they change to bone. This process of ossification—bone making—commencing at fixed points involves gradually the surrounding cartilage. These points are termed **centres of ossification.**

CHEMICAL COMPOSITION OF BONE.

The chemical composition of bone consists of two principles—1st, earthy or inorganic matter; 2nd, the animal or organic matter. The earthy may be removed by macerating it in a dilute solution of nitric or hydrochloric acid: the bone still retains its form, but becomes so flexible that it may be tied into a knot. The organic matter may be also removed by burning the bone in a fire: in this condition it loses its cohesive and elastic properties, and may be powdered between the fingers.

The following analysis exhibits the proportion of various salts:—

Animal matter	31·11
Phosphate of lime	59·14
Fluoride of calcium	2·23
Carbonate of lime	6·32
Phosphate of magnesia	1·20
	100·00

STRUCTURE OF BONE.

Anatomical analysis shows that bone is composed of two kinds of tissue—an external *compact*, and an internal which resembles lattice-work, and is termed *cancellated tissue*. If we examine these parts with a magnifying glass we observe a beautiful arrangement of small openings or canals, **Haversian,** which run in the direction of the long axis of the bone; they are surrounded by a series of concentric bony rings, **lamellæ,** also between them lie small stellate cells, **lacunæ,** which have delicate tubes, **canaliculi,** that run towards the Haversian canals.

Bones are covered by a dense white fibrous membrane, **periosteum,** which forms a matrix for the blood vessels and nerves which pass into the structure of the bone. By this means it is attached to the structure it covers.

The **endosteum** is a thinner and more vascular membrane which envelopes the fat or marrow in the medullary canal, and unites with the periosteum through the medium of the Haversian canals.

For the convenience of description the skeleton is divided into several parts, as the *head*, *neck*, *trunk*, and *extremities*. These are again sub-divided into regions, each of which will be considered in detail, viz.: *cranial*, *facial*, *cervical*, *dorsal*, *lumbar*, *sacral*, *caudal*, and afterwards the *extremities*.

THE CRANIUM.

The **cranium** consists of twelve bones—four pairs and four single. The *occipital*, *triquatrum*, two *parietal*, two *frontal*, four *temporal*, *sphenoid* and *ethmoid bones*.

OCCIPITAL BONE.

The **occipital bone** forms the posterior boundary of the cranium, and also the segment by which the head articulates with the neck. It is bent upon itself so as to project

upwards and forwards. At the angle formed by those parts exists an opening, *foramen magnum*, bounded on either side by an oblique articulatory prominence, *condyle*. These are separated from two processes, *styloid*, by the **condyloid fossa.** At the bottom of each fossa there exists a small opening, **condyloid foramen.** The projection which looks forwards, *basilar process*, articulates with the **sphenoid**; the one which turns upwards terminates in an eminence, **occipital crest.** This last portion has two surfaces—an external, presenting a roughened process, **cervical tuberosity**; and an internal, presenting three fossæ for lodging the lobes of the cerebellum. The occiput articulates with the *atlas*, *os triquatrum*, two *parietal*, four *temporal*, and *sphenoid bones.*

OS TRIQUATRUM.

Os triquatrum is a small shield-shaped portion of bone with a smooth and flat superior surface and dentated margins. It joins the *occipital* bone and lies before it: being on the middle or top of the cranium.

PARIETAL BONES.

The **parietal** consists of two pieces placed between the occiput and frontal bones. Each segment is a flat bone arched, being smooth and convex on its outer aspect, grooved and concave upon its inner. It forms a considerable portion of the *Cranium*. The parietal articulates with the *frontal*, *triquatrum*, *occipital*, *sphenoid*, and two *temporal* bones.

FRONTAL BONE.

The **frontal** bone is also double, at least in early life, and enters into the formation of both the cranium and face. It has two surfaces—an external and internal. The external surface is smooth and flat, presenting a slightly arched process, **supra orbital,** which projects outwards to articu-

late with the *zygomatic process* of the *squamous temporal* bone. At the root of this process exists the **supra orbital foramen.** The internal surface is grooved and completes the formation of the cranium. The facial portion of the bone is peculiar in having a cavity in its interior, **frontal sinus,** which communicates with the nasal cavities, and in old age with its fellow upon the opposite side. It articulates with the *nasal*, *lachrymal*, *superior maxillary*, *palatine*, *parietal*, *temporal*, *sphenoid*, and *ethmoid bones.*

SPHENOID BONE.

The **sphenoid** bone is so called from its wedge-like form, and has also been likened to a bird in flight. Its wings, *alæ*, arise from the supra-lateral parts of the body, and are directed upwards and outwards. The legs, *pterygoid processes*, are directed downwards and forwards. The body is cylindrical and directed in an antero-posterior direction. The bone is formed of two parts—an anterior and a posterior. The former presents, on its superior aspect, a slight eminence, *olivary process*, in front of which exists a transverse groove, *optic fossa*, leading into two canals termed the **optic foramina**; and on its anterior extremity a small process, **ethmoid spine,** for articulation with the *crista galli* of the ethmoid bone. The posterior portion of the bone presents on its upper surface a fossa, **sella turcica**, on each side of which is situated a groove, **cavernous fossa.** Where the two portions of the bone meet, they form a space, **sphenoidal fissure,** which is subdivided into a large external opening, **foramen lacerum orbitale,** and a smaller internal one, **foramen patheticum.** Posteriorly to this fissure exists a circular canal, **foramen rotundum,** and anteriorly the **optic fossa** and **foramina.** At the base of the pterygoid processes exists a small canal **pterygoid foramen.** the sphenoid articulates with all the

bones of the *cranium*, and with the *vomer* and *palatine* bones of the face.

TEMPORAL BONES.

The **temporal** bones are two in number, each of which consists of two parts—a *squamous* and a *petrous* portion.

The **squamous** portion presents for consideration two surfaces and a circumference. The external surface is convex and bounds the *temporal fossa*; from its medium part projects a process, **zygomatic**, which turns forwards and terminates by a sharp border which articulates with the *malar* and *superior maxillary* bones; on its inferior aspect exists a shallow fossa, **glenoid cavity**, bounded anteriorly and posteriorly by the anterior and posterior glenoid processes. The internal surface is concave and marked by numerous grooves similar to the other bones of the cranium. This portion articulates with the *parietal*, *sphenoid*, *frontal*, *malar*, and *superior maxillary* bones.

The **petrous** portion is situated between the *squamous temporal*, *occipital*, and *parietal* bones. Its form is irregular, and presents four surfaces, four borders, a base, and an apex. The anterior surface is related to the *parietal* bones; the posterior with the *occiput*; the external with the *squamous* portion; the internal surface is concave and contains a large opening, **meatus auditorius internus**. The base presents the orifice of a bony canal, **meatus auditorius externus**, a rounded process, **mastoid**, a smaller pointed one, **styloid**, an eminence surrounded by a sheath, **hyoid process**, and the orifices of *mastoid* and *styloid foramina*. It articulates with the *squamous temporal*, *occipital*, and *parietal*. This bone is of great importance, as it contains the organs of the middle and internal ear.

ETHMOID BONE.

The **ethmoid** bone forms the boundary between the

cavities of the cranium and nose. It consists of three parts—a central and two lateral. The central is formed of a thin lamina of bone articulating superiorly with the frontal bone; inferiorly with the sphenoid; anteriorly with the cartilaginous septum of the nose; and posteriorly it forms a ridge, **crista galli**, within the cranium, giving attachment to the *falciform process* of the *dura mater*.

The lateral parts consist of two spongy bodies attached on each side to the median plate, and posteriorly to the perforated laminæ of the bone called the **cribriform plates.** Each body is composed of a number of delicate laminæ of bone rolled upon themselves in the form of cones. They are connected posteriorly to the plate above mentioned, and have their anterior extremities projecting into the nasal cavities, where they are covered by the mucous membrane of the nose. It articulates with the *sphenoid*, *frontal*, *palatine*, *lachrymal*, *turbinated*, *superior maxillary*, and *vomer*.

THE BONES OF THE FACE.

The Bones of the Face are nine pairs and two single bones:—the *nasal*, *turbinated*, *superior maxillary*, *lachrymal*, *malar*, *anterior maxillary*, *palatine*, *pterygoid*, and *inferior maxillary*, the *vomer* and *hyoid*.

NASAL BONES.

The **nasal** bones are two in number, each of which is triangular in form and elongated in an antero-posterior direction. It presents two surfaces, two borders, a base, and an apex. The external surface is smooth and convex. The internal concave from side to side, and gives attachment to the superior turbinated bone. The external border is sharp, the internal thick and denticulated. The base is convex and bevelled. Its apex ends in a point which gives

attachment to the cartilages of the nose. The inner surface, correspondingly concave, is partly occupied by the expanded upper portion of *septum nasi*, but inclined to its outer side it presents a ridge for the attachment of the superior turbinated bones. The nasal bones articulate with the *frontal*, *lachrymal*, *superior* and *anterior maxillaries*, *superior turbinated*, and its fellow on the opposite side.

TURBINATED BONES.

The **superior turbinated** bones are extremely thin and feeble in the dried subjects, but when fresh they are coated on both sides with mucous membrane, which supplies them with nutriment and renders them elastic. Each of them consists of two portions, one anteriorly placed belonging to the nasal chamber, the other to the sinuses of the head.

The **inferior turbinated** bones are attached to the nasal surface of the superior maxillary bone.

SUPERIOR MAXILLARY BONES.

The **superior maxillary** bones are two in number. Each is an irregular bone presenting two surfaces, two borders, and two extremities. The external surface presents a ridge, **superior maxillary spine**, which becomes continuous with the **zygoma**, also a large aperture, **infra orbital foramen**. The internal surface enters into the formation of the nose, and presents a horizontal process, **palatine**, which joins its fellow of the opposite side in the mesian line. These two processes form the floor of the nasal cavities and the roof of the mouth. The superior border is thin and convex; the inferior is thick and convex, and contains six alveoli for the molar teeth. Behind the teeth there is a large process **alveolar tuberosity**. The internal border articulates with its fellow. The posterior extremity

is thick and rounded, and presents a large hiatus leading into three canals—the *lateral nasal*, *palatine*, and *infra orbital foramina*. The anterior extremity is squamous and contains cavities for the tushes. This bone, like the frontal, contains a large cavity—the **superior maxillary sinus.** It articulates with the *frontal*, *palatine*, *squamous portion of temporal*, *lachrymal*, *nasal*, *malar*, *anterior maxillary*, and its fellow on the opposite side.

LACHRYMAL BONES.

The **lachrymal** bones are two in number, each of which is thin, flattened, and bent upon itself. It presents two surfaces and a circumference. The external surface is sub-divided by a crest which forms the margin of the orbital cavity into an anterior or facial and a posterior or orbital portion; the latter presents a depression, **lachrymal fossa,** leading into a canal, **lachrymal foramen;** the internal surface enters into the formation of the nasal cavity and frontal sinus. It articulates with the *frontal*, *nasal*, *malar*, and ***superior maxillary bones.***

MALAR BONES.

Zygomatic or **malar bones** are two in number, each of which is placed upon the antero-external aspect of the orbit. It is triangular in shape, and presents two surfaces, two borders, a base, and a summit. The external surface forms a portion of the orbital cavity, the internal enters into the formation of the maxillary sinus. The superior border is thin, the inferior thick and forms part of the zygomatic crest; its base is directed forwards, its apex is elongated and directed backwards to join the zygomatic process of the temporal bone. It articulates with the *lachrymal*, *temporal*, and *superior maxillary bones.*

ANTERIOR MAXILLARY BONES.

The **anterior maxillary** bones are two in number. Each

presents anteriorly a bulging portion, and posteriorly two elongated projections. The anterior part possesses three surfaces—an external or labial, an inferior, which is concave and marked by depressions, **alveoli,** for the incisor teeth, and an internal surface denticulated for articulation with its fellow. Between these two surfaces exists a canal which is called the **supra dental foramen.** The external elongated projection is the larger of the two, and articulates posteriorly with the *nasal* and *superior maxillary* bones. The internal projection is thin, and articulates with the *vomer* and its fellow on the opposite side. Between the alveolar portions of the bone and its lateral parts exists a small space, **fenestra incisiva.** It articulates with the *nasal*, *superior maxillary*, *vomer*, and its fellow on the opposite side. The *anterior maxillary bones* in the Ox and Sheep have no depressions as they have no incisor teeth in these bones.

PALATINE BONES.

The **palatine** bones are two in number, each of which is situated behind the palatine processes of the superior maxillary bone. It is divided into two parts—an anterior or small portion, and a posterior which is flattened from side to side. The anterior part presents two surfaces—a superior entering into the formation of the nose, and an inferior which forms part of the hard palate. The posterior portion presents two surfaces and three borders. The internal surface assists in forming the lateral part of the nasal cavity; the external forms part of the orbital cavity, and presents a groove which forms part of the *palatine canal*. The superior border is sharp and divided posteriorly, the inferior border thick, the posterior border squamous. It articulates with the *sphenoid*, *ethmoid*, *pterygoid*, *vomer*, and *superior maxillary* bone.

PTERYGOID BONES.

The **pterygoid** bones are two in number, placed upon the posterior parts of the palatine bones. Each is small, elongated, and flattened from side to side. Its external surface lies in contact with the palatine and pterygoid processes of sphenoid bone; its internal surface is covered with mucous membrane; its superior extremity is connected to the vomer, its inferior extremity enlarges and presents a pulley-like surface over which plays the tendon of the tensor palati. It articulates with the *sphenoid* and *palatine* bones.

INFERIOR MAXILLARY BONE.

The **inferior maxillary** bone is formed of two parts or rami, connected anteriorly but divergent posteriorly. Each part is bent upon itself, forming the angles of the jaw. It presents two surfaces, two borders, and two extremities. The external surface is roughened for muscular attachments, and presents anteriorly the orifice of the **infra-maxillary foramen.** The internal surface bounds the inter-maxillary space, and presents at its supra-posterior part the internal opening of the **inferior maxillary foramen**; this surface gives also attachments to the muscles. The inferior border is thick and rounded; its upper border contains the *alveoli* for the molar, canine, and incisor teeth. The anterior extremities are joined to each other, forming the symphysis of the lower jaw, in which exists a small canal **infra-dental foramen.** The posterior extremity consists of two parts—an elongated process, **coronoid,** and a transverse articulatory eminence, **condyle,** which enters into the formation of the **temporo-maxillary joint.** It articulates only with the *squamous temporal* bone.

VOMER BONE.

The **vomer** is a single bone placed between the nasal

cavities, so named from the resemblance of the corresponding bone in man to a plough-share. It presents two surfaces, two borders, and two extremities. The surfaces are smooth and covered by mucous membrane, the superior border is grooved for the reception of the cartilaginous septum of the nose. The posterior extremity is flattened for articulation with the sphenoid and ethmoid bones. It articulates with the *sphenoid*, *ethmoid*, *palatine*, *pterygoids*, and *anterior* and *superior maxillary* bones.

HYOID BONE.

The **os hyoides**, or bone of the tongue, is placed between the *rami* of the lower jaw. It consists of a body, two horns, and an appendix. The body is linked to a spur with the two projections posteriorly, and the spur process in front, which gives attachment to the tongue. The horns, or cornua, consist of two greater and two lesser portions. The greater is formed of two flattened pieces connected superiorly to the styloid process of the temporal bone; inferiorly with the lesser horns, and on each side with the muscles of the tongue and pharynx. The lesser horns are about an inch and half in length, and articulate inferiorly with the body of the bone, superiorly with the greater horns. It articulates with one bone—the *petrous temporal* bone.

BONES OF THE HEAD.

SUMMARY.

The bones of the head are so arranged as to form large apertures and fossæ. On either side of the median line there exists an irregular aperture, **foramen lacerum basis cranii**, formed by the *sphenoid*, *occipital*, and *petrous portion of temporal* bone. On each side of the cranium exists a

two anteriorly and one posteriorly. Its body is represented by a small tuberosity. Anteriorly exist two large concave facets for articulating with the occipital bone. Posteriorly a small concave facet on each side for articulation with the odentoid process of dentata.

The *second*, **axis**, *(plate* 1, *D)*, or **dentata**, the largest in the cervical region, is distinguished by a projection in front, *odentoid process*. This process presents a smooth surface inferiorly for articulating with the atlas, posteriorly a concavity for articulation with the head of the third cervical vertebra. The laminæ are strong and terminate superiorly in a large spine which bifurcates posteriorly. The body is long; the inferior spine is sharp and well developed. The transverse processes are thin, single, and pierced at the root by the vertebral foramen. The anterior inter-vertebral foramina are formed in the pedicles of the bone.

The *third, fourth, and fifth vertebræ* are similar. The transverse processes are bifid. The *sixth* may be distinguished by its transverse process being trifid, and the absence of the inferior spine. They contain, at the roots of the transverse processes, the vertebral foramina.

The *seventh vertebra* resembles the dorsal vertebræ by the great length of its superior spine, and has two semi-facets at the postero-lateral parts of the body for articulating with the anterior half of the head of the first rib. The transverse processes are single and not pierced by the vertebral foramina. (*Plate* 1, *E*).

DORSAL VERTEBRÆ.

The **dorsal vertebræ** are eighteen in number, intermediate in size between those of the cervical and lumbar regions, and may be distinguished by the great length of their superior spine. On either side, anteriorly and posteriorly,

each body presents two small semi-facets, which, with the intervening cartilage and contiguous vertebra, form facets (a small circumscribed surface of a bone), for articulating with the head of a rib. The head is less prominent, and the cavity posteriorly is shallow. The *laminæ* are narrow and surmounted by a large projection, **superior spine**, which is flattened from side to side, and tuberous at its superior part; the superior spines are directed more or less from before backwards. The articular, **oblique processes**, are small and tuberous; the anterior pair are directed upwards and forwards; the posterior pair are directed downwards and backwards. The transverse processes are small and tuberous; they present on their lateral parts a small facet for articulation with the tubercle of the ribs. Notches smaller than in the cervical region.

The dorsal vertebræ do not essentially differ from each other, except the fifth and sixth, which have the longest superior spine. In the first twelve the spinous processes are considerable for the purpose of giving a long lever to the shoulder muscles; it is these that give height to the withers, and as they are covered with muscles that act powerfully, so their length is of great consequence to progression. Between each is interposed a substance of the mixed nature of cartilage and ligament, which is most compressible at its sides, permitting the motion of the spine, and forming, by the solidity of its centre, a fulcrum or pivot for the bones to move on. This interposed substance loses its elasticity in old horses and becomes nearly converted into bone. The last dorsal has no facets upon the sides of its posterior extremity.

LUMBAR VERTEBRÆ.

The **lumbar vertebræ** *(plate 1, E.)* are six in number, and may be distinguished by the great length of the transverse processes. The bodies are large, the head is slightly

prominent, and the corresponding cavity shallow. The superior spines are not long, but thick and tuberous at their superior parts. The transverse processes are long and flattened from above downwards; the two first are directed backwards, the third straight out, and the three last are directed forwards; the fifth and sixth have small facets on the transverse processes for articulation with each other. The facets on the posterior border of the transverse processes of the last are largely developed, and articulate with the *sacrum*.

SACRAL VERTEBRÆ.

The **sacral** *(plate* 1, *H.)* region is composed of five segments ossified into one piece, **sacrum**. It is of a triangular shape, having its base anteriorly, and its apex posteriorly. It is slightly arched, with its concavity inferiorly, and possesses two surfaces, two borders, a base, and an apex. The superior surface presents five tuberous spines; the inferior surface is smooth and concave; on each border there exists an irregular surface for articulating with the ilium. The base has on each side of its articulatory head an oval facet, corresponding to those upon the transverse processes of the last lumbar vertebra. The inter-vertebral foramina are double, each having a superior and inferior orifice.

COCCYGEAL OR CAUDAL VERTEBRÆ.

The **coccygeal** or **caudal vertebræ** are fourteen to eighteen in number. They show more or less, in a rudimentary form, the essential parts of a vertebra, and are peculiar in having their anterior and posterior surfaces convex. The three first vertebræ are nearly perfect, but from the fourth backwards, the vertebral elements gradually disappear until the body is the only part which remains.

OF THE SPINE IN GENERAL.

The **spinal** column presents for consideration several peculiarities. *The head and first bone of the neck* have very free motion, principally upwards and downwards, as when the horse tosses his head. The joint formed by the next bone of the neck with the first has likewise a very easy movement, but it is chiefly towards either side, or rotatory, as when the animal shakes his head or looks round about him. The remaining neck bones move very freely altogether, though but slightly upon one another; they come into play whenever the horse turns his head to one side or the other, likewise when he raises the head upward or bends it downward.

The *bones of the back* have the least motion of all, their function being to confer strength and to permit of the motion of the ribs.

The *bones of the loins* have more motion, particularly the last, which is rather loosely articulated with the first bones of the sacrum.

The *spinal column* serves to hold and safely lodge the spinal marrow, there being holes in the sides of the bones which admit of the passage of the spinal nerves.

THORAX.

The **thorax** or **chest** is a cavity which contains the principal organs of respiration and circulation. It is bounded by osseous and cartilaginous walls, and is conical in form, having its apex anteriorly and base posteriorly. The thorax is bounded superiorly by the dorsal vertebræ, which have been described; laterally, by the ribs and their cartilages; inferiorly, by the sternum.

RIBS.

The **ribs** are eighteen in number on each side. They are divided into *eight true* or *sternal*, and *ten false* or *asternal*.

Each rib is a long bone consisting of a body and two extremities, more or less twisted upon itself. The body presents two surfaces and two borders; the external surface is convex and marked posteriorly by a groove; the internal surface is smooth and concave; the anterior border is thin, the posterior thick and rounded. The superior extremity consists of two parts—a head and a tubercle; the head presents two articulatory surfaces separated by a roughened groove, and is joined to the body of the rib by a constriction or neck; the tubercle presents an articulatory surface, postero-superiorly for articulation with the transverse process of a dorsal vertebra. The inferior extremity is concave for the reception of the costal cartilage.

The Ox and Sheep have thirteen ribs, *eight true* and *five false*. The true ribs in the Ox are considerably longer, larger, thicker, and further apart from each other than in the Horse. They are so formed as to render the cavity of the chest of a far more circular shape than in the Horse.

PECULIARITIES.

The first rib is straight, and presents a notch upon its anterior border; the ninth is the longest, and the eighteenth has its tubercle confounded with the head. They increase in size from the first to the ninth inclusive, and decrease from the ninth to the eighteenth.

COSTAL CARTILAGES.

The **costal cartilages** are the same in number as the ribs, and are divided into true and false. Those of the true ribs are small cylindrical pieces, slightly flattened from side to side, and smooth upon their surfaces and borders. The superior extremities are the larger of the two, and are received into the depressions upon the lower extremities of the ribs. The inferior extremities are convex from

before backwards, and articulate with the fossæ upon the lateral surfaces of the sternum. Those of the false ribs are slighter in form, more elastic, and terminate in blunt points, which are united to the cartilages in front by yellow fibrous tissue.

STERNUM.

The **sternum** or **breast bone** is formed of six segments joined together to form a single bone. It is placed in the antero-inferior part of the thorax in the median line, and directed from above downwards and backwards. It presents three surfaces—a superior and two lateral; also three borders—an inferior and two lateral, and two extremities. The superior surface is slightly concave, narrow anteriorly, and broad posteriorly; the lateral surfaces are broad anteriorly and narrow posteriorly; each presents eight fossæ for the reception of the true costal cartilages. The lateral borders give attachment to the sterno costal ligaments. The inferior border (resembling the keel of a ship) is curved anteriorly, giving attachment to a cartilage, **cariniform,** which is flattened from side to side; the posterior part is also connected to a cartilage, **ensiform,** which is flattened from above downwards, and convex upon its posterior border.

In the Ox the *sternum* is thin and flat. It presents a level surface of considerable width for the floor of the chest. It has also a process projecting very considerably anteriorly. This process has a joint which is not found in the Horse. It admits of a certain degree of lateral action only, and materially assists in walking.

ANTERIOR EXTREMITIES.

The **anterior extremities** of the Horse are peculiar so far that they are connected to the trunk only through the medium of muscles. Each is formed of a series of seg-

ments composed of one or more bones which articulate with one another, so as to endow the limb with the necessary mobility for performing the various movements of locomotion.

These segments are the *shoulder*, *arm*, *fore-arm*, *carpus*, *metacarpus*, and *phalanges*. The shoulder is composed of one piece called the **scapula.**

SCAPULA.

The **scapula** or **shoulder-blade** *(plate* 1, *J.)* is a broad and rather triangular bone, applied to the outside of the ribs, with its narrowest point downward between the first and second ribs, and its broad and thin expansion upward as far back as the seventh; it therefore extends obliquely along the chest. Its internal surface is slightly hollowed and smooth; its external is divided into two unequal portions by a projecting ridge or spine. Its anterior edge, as it continues down, contracts inwards, and ends in a blunt rounded extremity. Its superior surface is furnished with a considerable cartilage, covered with strong ligamentous fibres, by means of which the surface of muscular attachment is much increased. The posterior edge of the scapula inclines inwards, and ends in its neck, the bulging part immediately below the neck presenting a shallow cup to receive the head of the *arm-bone* or *humerus*. *(See plate* 1, *K.)*

Attached to the base of the scapula is a plate of cartilage, which diminishes in thickness as it ascends from the bone; it is convex at its superior part, and overlaps the posterior border of the bone. In aged animals it becomes ossified.

HUMERUS.

The **humerus** *(plate* 1, *K.)* is strong, short, and very unlike the same bone in man. It extends from the point of

the shoulder to the elbow, forming an angle with the scapula. At the anterior part of the upper extremity it stretches out into a round head, having about it a circular indentation for the insertion of the capsular ligament of the joints. The body of the humerus presents an external tuberosity and an internal tuberosity for the insertion of muscles; proceeding downwards it terminates in two rounded bodies that are termed **condyles**, which are received into articular cavities in the superior extremity of the radius, and allow of the limb being bent and straightened. In the front of this extremity is a cavity to receive the protuberances of the radius in the greatest flexions of the fore arm, and behind there is a very deep depression for the reception of the bone of the elbow when it is again extended. The humerus articulates with the *scapula* superiorly, the *radius* inferiorly, and the *ulna* posteriorly.

FORE-ARM.

The **fore-arm** (*plate* 1, *L.*) consists of two bones, the *radius* and *ulna*, which are slightly moveable upon each other in early life, but become fixed in the adult state.

RADIUS.

The **radius** is a long bone, having a cylindrical shaft, smooth and convex anteriorly; flat and roughened posteriorly, where it articulates with the ulna. The *superior extremity* is enlarged, so as to form two shallow concavities parted by a slight ridge, an exact counterpart of the lower extremity of the humerus. At the anterior part of articulatory margin a small process, **coronoid**; also, a little beneath this and to the inner side, a roughened eminence called the **bicipital tuberosity**; upon its posterior surface are situated two small facets for articulation with similar ones upon the ulna. The *inferior extremity* is irregularly

concavo-convex, presenting a small aperture upon its postero-external surface, corresponding to an eminence upon the semi-lunar bone. Antero-inferiorly are four grooves for the passage of the tendons of various muscles. It articulates with the *humerus* superiorly, *ulna* posteriorly, and inferiorly with the *first row of carpal bones*, four in number.

ULNA.

The **ulna** is a long bone which tapers from above downwards, and terminates about the lower third of the radius. Its upper extremity is surmounted by a large roughened prominence, **olecranon,** flattened from side to side, and projecting slightly backwards and upwards ; at the junction of this process and the body is situated a shallow articulatory groove, **sigmoid,** which articulates with the *humerus* ; a little below this is situated two small *facets*, corresponding to those upon the radius ; between the two bones about its upper third is a small space, **radio-ulnar arch,** and near to this is the nutrient foramen of the bone. It articulates with the *humerus* and *radius*.

CARPUS.

The **knee** or **carpus** *(plate* 1, *M.)* corresponds to the wrist of man. In most of the articulated skeletons there are seven principal carpal bones ; in the recent subject, where the horse is carefully dissected, there is sometimes found a small bone of the shape and size of a pea situated behind the trapezoid, with which it is articulated. With this the knee consists of eight bones named and arranged as follows in two rows. The **scaphoid**, occupying the inner side of the upper layer ; the **lunar,** the centre, and the **cuneiform** the outer side ; the **trapezoid** inner ; **magnum** middle ; **unciform** outer side of the lower row. The **trapezium** is situated behind, and articulated to the **cunei-**

form, consequently occupying the outer side of the knee, and the small bone alluded to as pea-shaped is called the **pisiform,** and is found behind the **trapezoid** bone. The characters of these bones are somewhat similar in all; they are irregular in shape, and possess small facets where they are in apposition with other. The upper row forms an articulatory surface adapted to that upon the lower extremity of the radius; the inferior surface of upper row presents a slight convexity for articulation with the superior surface of lower row. The under surface of lower row is nearly flat, and articulates with the bones of the **metacarpus.**

TRAPEZIUM.

The **trapezium** (*plate* 1, *N.*) in projecting posteriorly forms a point for the insertion of muscles, and acts as an excellent protection to the flexor tendons as they pass behind the knee. The uses of the *pisiform* are not correctly ascertained. The bones of the knee articulate with each **other, and serve to lessen concussion.**

METACARPUS.

The **metacarpus** (*plate* 1, *O.*) is formed of three bones, one large and two small, commonly called **splint bones.**

The **large metacarpal** is a long bone, having a rounded shaft, with a smooth convex surface anteriorly, and posterior slightly flattened, and presenting on its outer and inner aspects a roughened surface for articulation with the splint bones. The upper *extremity* has a flat articulatory surface in adaptation to the inferior surface of the lower row of carpal bones. Upon its antero-internal surface superiorly exists a roughened eminence for the insertion of the extensor metacarpi magnus. Its *lower extremity* is formed of two condyles, which are situated in an antro-posterior direction, and separated in the mesian line by a **ridge.**

The **small metacarpal** bones are two in number; they are long bones of pyramidal form, situated posteriorly upon the inner and outer aspects of the canon bone. Their *superior extremities* are enlarged and present a smooth surface for articulation with the lower row of carpal bones; also a little below this, two small facets for articulation with those situated upon the large metacarpal bone. Their *inferior extremities* terminate about the lower third of the canon bone in a bulbous point called the **button**, which is detached foom the large metacarpal bone. In young life the bones of the metacarpus possess slight mobility, but very soon become ossified. The *internal splint* bone is the thicker and longer of the two, and presents two facets upon its superior surface for articulation with the *trapezoid* and *os magnum*.

PHALANGES.

The **phalanges** are three in number—the *os suffraginis*, *os coronæ* and *os pedis* (*plate* 1, *P.*, *Q.*, *R.*, *S.*).

OS SUFFRAGINIS.

The **os suffraginis** or **pastern** is a long bone placed obliquely from above downwards and forwards. Its shaft is cylindrical, presenting a triangular roughened surface for ligamentous insertion. Its upper extremity is enlarged so as to form two shallow concavities separated by a median groove, adapted for articulation with the inferior extremity of the *canon* bone. Antero-superiorly it presents a slight eminence for the insertion of the *extensor suffraginis;* posteriorly it articulates with the two *sesamoid bones*. Its inferior extremity articulates with the *os coronæ*, and is formed by two small convex surfaces situated in an antero-posterior direction, separated by a median shallow groove.

SESAMOID BONES.

The **sesamoids** (*plate* 1, *Z.*) are two irregular bones situated behind the posterior part of the *os suffraginis.* They are of a triangular shape, with their apex superiorly and their base inferiorly. The anterior surface presents two concavities separated by a deep groove, for the reception of the inferior extremity of the large *metacarpal* or *canon* bone. The posterior surfaces are convex, and marked by a groove for lodging the tendons of the *flexor pedis perforans* and *perforatus.* The inferior parts of the base and lateral aspects are roughened for ligamentous attachments.

The use of these bones is more important than, from their size, a casual observer might be disposed to think. Their strongest attachment is to the great pastern bone; their weakest to the suspensory ligament. In horses with very oblique pasterns, part of the large *metacarpal* bone always rests upon the sesamoids; and we can readily understand how such a formation must contribute to weakness as well as to the grace of the animal's paces and the ease of the rider.

Horses with very erect pasterns hardly ever have the sesamoids depressed by the canon bone; hence we can account for their want of elasticity, as well as danger to themselves, when put beyond a walk.

OS CORONÆ.

The **os coronæ** is nearly square, presenting four surfaces for consideration. The superior surface is the exact counterpart of the inferior extremity of the os suffraginis. Its inferior surface possesses two slight convexities separated by a median groove. The anterior surface is roughened for ligamentous attachments. Its posterior surface is smooth and intimately connected with the *glenoid fibro cartilage;* upon its outer and inner aspects

it is roughened for the attachment of the tendon of the *flexor pedis perforatus* and ligaments. It articulates with the *os suffraginis*, *os pedis*, and *navicular* bones.

OS PEDIS.

The **os pedis** is a very peculiar bone. In shape it corresponds with the hoof, which, with its appendages, it almost fills; in structure it is very porous; having its bony fibres perpendicularly placed so as to give it a rough linear appearance. When viewed in front an eminence is seen at the upper part, to which the tendon of the *extensor pedis* is attached; its lateral parts are not so high, but project further back, and form two lateral processes which are always distinct, and are called its wings.

Upon the inner surface of these wings is a groove for an artery, which forms a semicircle within the substance of the bone, and sends off branches to the internal and external parts. Above the wings are concavities which receive the two side cartilages of the foot. Around the outer surface of the *os pedis* are placed the sensible *laminæ*, which are very firmly attached to the roughened exterior. The inferior surface of the *os pedis* is concave for the reception of the sensible sole; and, though this part is far from smooth, yet it is by no means so rough as the other parts of the same bone. The porous nature of the os pedis answers three intentions:—first, it gives lightness as well as solidity to the foot; secondly, it affords protection to the nerves and vessels which ramify within its interior; thirdly, it gives ample attachment to the various structures covering its exterior; and thus bestows strength and durability to the foot. It articulates with the *os coronæ* and *navicular* bones.

NAVICULAR.

The **navicular** bone is a sesamoid elongated transversely,

presenting two surfaces, two borders, and two extremities. The superior surface resembles that of the os pedis; the inferior surface is smooth and slightly concave, for the gliding of the tendon of the flexor pedis perforans; it is partly divided by a slight elevation in the centre. The anterior border possesses a facet corresponding to that upon the posterior part of the os pedis; the posterior border is roughened for ligamentous attachments. The two extremities are more or less pointed, and are connected to the wings of the pedal bone by white fibrous tissue.

POSTERIOR EXTREMITIES.

The **posterior extremities** differ much from the *anterior* not only in the strength of the parts generally, but in the length and direction of the bones entering their formation. They are also applied directly against the spinal column. The hind limbs are divided into the following parts:—*pelvis os innominata* or *haunch*, *femur* or *thigh*, *patella* or *stifle-bone*, *tibia* and *fibula* or *leg*, *tarsus* or *hock*, *metatarsus* and *phalanges*.

PELVIS OR OS INNOMINATA.

The **os innominata** or **haunch** bone, forms the medium by which the limb becomes connected to the spinal column: it is a very irregular bone, composed of three segments—the *ilium*, *ischium*, and *pubis*, which unite and form a cavity called the **acetabulum**, by which it articulates with the thigh bone: they also form the boundaries of the pelvic cavity.

The **ilium**, the largest of the three, is a flat bone, triangular in shape and slightly bent upon itself, so as to form a cavity upon its external aspect and a convexity upon its inner. Its base is directed upwards and forwards, the internal angle looking inwards, and the external look-

ing outwards to form the prominence of the haunch. The external angle is double, presenting two roughened tuberosities called the *antero-superior* and *antero-inferior* spines of the ilium. The anterior and posterior borders are concave; the external surface smooth; the internal roughened, more especially the portion that articulates with the inferior part of the *sacrum*.

The **ischium**, the next bone in size, forms with the pubis the floor of the pelvis. It is a flat bone, smooth, and slightly concave on its upper surface, and roughened upon its lower parts; its external border is smooth and rounded; the internal is roughened, and unites with its fellow upon the opposite side. The posterior border presents at its external angle a large protuberance, **ischiatic tuberosity**, also inferiorly a ridge, **ischiatic crest**; while, running from the tuberosity forwards, a short distance on its outer margin is a crest called the **ischiatic spine**. The anterior border is bifid, one part entering into the formation of the *acetabulum*, the other portion joins the os pubis to form the *obturator foramen*.

The **pubis** is a small flat bone, smooth upon its upper surface, rough and marked with a deep groove, **prepubian**, upon its lower. Its anterior border is rough and concave; its posterior has two projections, one of which joins the ilium to form the *acetabulum*, the other assists in forming the *obturator foramen*.

The **acetabulum** or **cotyloid cavity** has a deep notch upon its inner border, and a small scabrous fossa upon its upper part for the insertion of the round ligament. Where the *ilium* and *ischium* meet there is a prominent crest situated above the *acetabulum*, **supra cotyloid crest**, and where it joins the *pubis* anterior to the *acetabulum*, another called the **ilio pectineal crest**. The *ilium*, above the *cotyloid cavity*, is very much constricted *(neck)*, and situated upon it is the nutrient foramen of the bone.

The **os innominata** articulates with the *sacrum* superiorly, and *femur* inferiorly; also its fellow in the median line, forming the *symphysis*.

FEMUR.

The **femur**, or **thigh bone** (*plate* 1, *V.*) is the largest, thickest, and strongest bone in the body. Its surface exhibits eminences and indentations for the attachment of the most powerful muscles. From its upper extremity extends the neck, supporting the rounded head by which it is articulated with the *pelvis*. Within the head is a cavity giving origin to a flat ligament, which retains the head of the bone in its situation. Below the head is inserted the *capsular ligament*. Upon the middle of the inner side of the bone is a small eminence called the *internal trochanter*. Immediately in front, and slightly behind the head of the bone, is a large eminence, known as the *great trochanter*; below it is a small projection named the *small external trochanter*. The use of each and all these projections is to give greater surface for attachment and thus aid the action of muscles. At the lower end, and to the front of the bone, is a large articulatory surface, forming a shallow groove, and bounded by a prominence on each side, the internal being the most projecting; in this slides the *patella* or *stifle bone*. Posteriorly and inferiorly are two convex projections, rounded and articulatory, resting on the head of the *tibia*, the bone immediately inferiorly placed; these are called *condyles*, and just above them is an indentation which affords origin to the gastrocnemii muscles.

PATELLA.

The **patella** (*plate* 1, *X.*) is a sesamoid bone, situated upon the antero-inferior part of the *femur*. It presents

for consideration two surfaces and four borders. The external surface is convex and roughened for muscular attachments; the inner or posterior surface possesses two shallow grooves, separated by a ridge corresponding to the trochlea of the femur. The borders are roughened for muscular and ligamentous attachments.

THE LEG.

The **leg** is formed by two bones—the *tibia* and *fibula*.

TIBIA.

The **tibia** (*plate* 1, *V.*) is the chief bone of the leg; it is a long bone directed from above downwards and backwards. Its shaft is of a triangular form, having three surfaces and three borders; the external surface is slightly concave and smooth; the inner and posterior surfaces are flat and roughened; the latter also contains the nutrient foramen of the bone. The external border is sharp and prominent upon the upper third of the bone, and forms the tibial crest. The superior extremity is formed of two slightly convex articulatory surfaces, also three tuberosities separated by the tibial spine. The external tuberosity presents a small facet for articulation with the fibula; the internal is roughened for muscular insertion; also between these tuberosities posteriorly exists a deep notch called the **popliteal groove**. The anterior tuberosity presents a slight groove for the attachment of the straight ligament of the patella; this tuberosity is continuous with the tibial crest. The inferior extremity is formed of two deep grooves separated by a sharp ridge directed from within outwards and forwards; upon its outer and inner sides are situated tuberosities called the **external** and **internal malleoli**. It articulates with the *femur*, *patella*, *fibula*, and *astragalus*.

FIBULA.

The **fibula** is placed upon the postero-external aspect of the tibia; it is a long bone with its shaft tapering inferiorly, and extending as far as the lower third of the tibia. Between this bone and the tibia exists a space called the **tibial arch**. The upper extremity is flattened from side to side, and possesses upon its inner aspect a small facet for articulation with the tibia. Its lower extremity terminates in a sharp point, and becomes attached to the tibia by means of white fibrous tissue. The external surface is roughened for attachment of muscles. It articulates with the *tibia*.

THE TARSUS.

The **tarsus** or **hock** *(plate* 1, *Z.)* is a most complex and important joint, and though it consists of several bones these are so internally united as to appear a solid mass. It is formed of six bones arranged in three rows. The first row comprises the *astragalus* and *os calcis*; the second row the *cuneiform magnum* and *os cuboides;* the third row comprises the *cuneiform medium* and *parvum*.

ASTRAGALUS.

The **astragalus** is an irregular bone situated beneath the tibia, presenting five surfaces for consideration. The anterior surface is pulley-shaped, directed obliquely from above outwards, forwards, and downwards; the posterior surface presents four facets for articulation with the *os calcis;* the inferior surface is smooth and slightly convex, adapted for articulation with the second row of tarsal bones. The external and internal surfaces are roughened for ligamentous attachments; it has also upon its inner surface a small tubercle, **astragaloid tuberosity.** It articulates with the *tibia*, *os calcis*, *cuneiform magnum*, and *cuboid* bones.

OS CALCIS.

The **os calcis** is an irregular bone placed behind the astragalus. It projects backwards and upwards, forming the point of the hock. Its summit affords insertion for the gastrocnemous muscle. The longer, therefore, this process is the longer is the lever this muscle has to act upon, and a very slight increase or diminution in the length of this bone must enlarge or lessen the power by which the motion of the joint is effected. The *calcis* is placed so as to rise from the joint rather externally, and this formation leaves a space on the inner side for the flexor tendons of the foot to pass protected from pressure. It articulates with the *astragalus* and *cuboid.*

CUNEIFORM MAGNUM.

The **cuneiform magnum** is a flat bone with two surfaces and four margins, situated immediately beneath the *astragalus*: it is triangular in shape: it rests upon the *middle cuneiform*, also articulates with the *cuboid* and *small cuneiform bones.*

CUBOID.

The **cuboid** occupies the outer part of the lower row of hock bones, and is equal in thickness to the sum of the *cuneiform* bones, *magnum* and *medium*. This thickness is characteristic, and serves to distinguish it from all other bones; it is roughened for the insertion of ligaments, and presents six synovial surfaces for attachment to the great and middle cuneiform bones laterally; the *astragalus* and *os calcis* superiorly; the *large* and *external small metatarsals* inferiorly.

CUNEIFORM MEDIUM.

The *cuneiform medium* is a flat bone, situated at the lower (inclined to the inner) part of the hock. It may be distinguished from the *cuneiform magnum* by a projection

from the centre of its posterior margin, which is inclined slightly inwards. It rests upon the metatarsal bone, and has a small articulation with the *os cuboides* or next described bone.

CUNEIFORM PARVUM.

The **cuneiform parvum** is situated in the internal part of the hock; the smallest bone of the six; very irregular in shape; articulates superiorly with the *large cuneiform*, laterally with the *middle cuneiform*, below with the *internal small metatarsal* (principally), and also with the *large metatarsal.*

METATARSUS.

The **metatarsus** (*plate* 1, *a.*) is similar in construction to the metacarpal; the individual bones are relatively longer and more cylindrical than those of the anterior extremity. The large metatarsal bone is peculiar in having its superior surface divided into two parts by a depression. The external splint bone has two facets upon its upper surface for articulation with the cuboid bone. The internal splint bone has also two facets for articulation with the cuneiform bones.

PHALANGES.

The **phalanges** (*plate* 1, *b*, *c*, *d*, *e.*) are also similar to those of the fore limb: the *os suffraginis* is shorter; the last, or *os pedis*, being somewhat narrower and more perpendicular upon its anterior surface than the same bone of the anterior extremity; it is also more concave upon its inferior aspect.

ARTICULATIONS.

The various bones that compose the skeleton are connected together at different parts of their surfaces; such connections being designated by the name of *joints* or *articulations*, which are classified as follows:—

DIARTHRODIAL OR MOVEABLE JOINTS.

Name.	Nature	Motions.	Examples.
Enarthrodial	Ball and socket	Flexion, extension, adduction, abduction, rotation, and circumduction	Hip and shoulder joints
Ginglymus	Hinge	Flexion and extension	Elbow, pastern, and tibio-tarsal
Arthrodia	Plain surfaces	Gliding	Knee, hock, & articular process of vertebræ.
Trochoides	A pivot rolling in a ring	Rotation	Between atlas & axis

AMPHIARTHRODIAL OR MIXED JOINTS.

Name.	Nature.	Motions.	Examples.
Symphysis	Joined by tissue	Slight yielding	Inter pubic, inter ischiatic, & sacro-iliac

SYNARTHRODIAL OR IMMOVEABLE JOINTS.

Name.	Nature.	Examples.
Sutura dentata	Tooth like	Parietal and frontal
,, **squamosa**	Overlapped	Parietal and squamous temporal
,, **limbosa**	Where the bones are bevelled at different points.	Sphenoid and parietal
,, **serrata**	Saw like	Two portions of parietal bones
,, **harmonia**	Plane edges	Nasal bones
Gomphosis	As a nail in its socket	Teeth in alveoli of maxillary bones
Schindylesis	One split that receives the process of another bone	Wing of sphenoid in the frontal bone, or superior maxillary with nasal bones

FORMATION OF JOINTS.

The tissues that enter into the formation of moveable joints are *bone, cartilage, fibro-cartilage, ligaments, synovial membranes,* and *muscles.*

Bone constitutes the fundamental part of all joints. It is covered by a general investing fibrous membrane, called **periosteum**, receiving different names as it covers different parts. The uses of the *periosteum* appear to be to act as the medium whereby vessels are assisted in the ingress and egress to part of the bone. In a healthy state it has no sensation, but, like some other parts, when diseased it becomes very sensitive The ends of bones that enter into the formation of joints are somewhat enlarged, and composed of cancellated tissue covered by a thin layer of compact bone.

Cartilage forms a thin encrustation upon the articular surfaces of bones; it is a firm substance of a bluish white colour, having the property of elasticity which breaks the force of concussion. It consists of cartilaginous cells embedded in a structureless matrix, and gives freedom to the movements of joints, and lessens friction. It is covered by a membrane, **perichondrium,** which has a glistening appearance. On convex surfaces it is thickest in the centre, and in concavities it is thickest at its margin.

Fibro cartilage consists of cartilaginous cells embedded in a matrix of white fibrous tissue. Examples:—*intervertebral substance;* also the *semi-lunar discus* situated between the femur and tibia.

Ligaments are dense fibrous structures arranged either in the form of flat bands or bundles; also in a membraneous form composed of white fibrous or yellow elastic tissue; the former has a bluish white silvery appearance, the latter has a yellow colour and is very elastic. Example:—*ligamentum nuchæ.* Ligaments bind the ends of bones to-

gether and thus form a strong bond of union at articulations.

Synovial membrane is a thin membraneous layer which invests the articular cartilage of bones, and is reflected over the internal surface of joints; it forms closed sacs in the fœtus; it secretes a glairy fluid which facilitates the movements and lessens friction.

LIGAMENTS.

The principal **ligaments** of the spine are the *superior* and *inferior common ligaments*, and the *supra spinous*.

The **superior ligament** presents almost a serrated appearance, the teeth being some distance apart; this is owing to its expansion at the junction of the bodies of the vertebræ, the upper surface of which it covers; it extends along the spinal cord from the axis to the sacrum, and is attached to the intervertebral substances as well as to the vertebræ themselves.

The **inferior ligament** is a band extending along the bottom of the vertebræ; it arises at the eighth dorsal, and runs back to the sacrum.

The **supra spinous** consists of a ligament called the *ligamentum nuchæ* (*plate* 1, *f*), and the continuation of that strong band along the spines of all the vertebræ as far as the sacrum; it is divided into the funicular and lamellar portions. The *funicular* portion is the cord which suspends the head from the withers; the *lamellar* is that which fills up the space between the funicular and the cervical vertebræ. This ligament is mainly composed of yellow elastic tissue. The spines of the vertebræ are united by short ligaments, *inter-spinous*, so also are the laminæ of the vertebræ, the ligaments connecting which are named **inter lamellar**. There are also small ligaments proper to the atlas and axis. Every articular surface of the vertebræ has, of course, its *capsular ligament*.

LIGAMENTS OF THE HEAD.

The only ligament connected with the head which deserves notice is the capsular of the joint between the *temporal bone* and the *lower jaw*. The two articulatory surfaces are separated by a fibro-cartilaginous disc, which serves to separate the cavity of the joint into two distinct parts, each lined by synovial membrane. This disc is a flattened piece of cartilage elongated from side to side, and all round its outer margin is attached the capsular ligament of the joint.

OCCIPITO-ATLOID ARTICULATION.

The **occipito-atloid articulation** is formed by the condyles of the occiput and the anterior articulatory surface of the atlas. There is one ligament to this joint—the *capsular*, attached all round the posterior part of the occiput and the anterior border of the atlas. It is strengthened by numerous bands of fibrous tissue. This joint has two synovial membranes—one for each condyle.

AXOIDO-ATLOID ARTICULATION.

The **axoido-atloid articulation** is formed by the posterior articulatory surface of the atlas and anterior part of the axis. It has four ligaments :—

The **odontoid ligament** is a flattened band of a triangular form, with its base anteriorly and its apex posteriorly; attached posteriorly to the upper surface of the odontoid process, anteriorly to the superior aspect of the body of the atlas; and a few fibres pass forwards and are attached to the inner surface of the condyles of the occiput.

The **superior axoido-atloid ligament** is composed of two layers of elastic tissue attached posteriorly to the superior part of the axis, anteriorly to the supra-posterior part of the atlas, and becomes continuous with the capsular ligament.

The **inferior axoido-atloid ligament** is a thin band of fibrous tissue attached anteriorly to the tubercle upon the inferior surface of the atlas and posteriorly to the inferior aspect of the axis.

The **capsular ligament** is continuous superiorly and inferiorly with the ligaments of this joint. It is attached round the posterior margin of the atlas and anterior margin of the axis; it is lined by a synovial membrane.

COMMON VERTEBRAL ARTICULATION.

This joint is formed by the bodies, arches, and processes of the vertebræ, and has seven ligaments.

Inter-vertebral discs.—These are placed between the bodies of the vertebræ to which they are adapted. Each disc is composed of a corticle and a medullary portion; the *corticle* is formed of concentric layers of fibrous tissue and cartilage; the *medullary* portion consists of a pulpy material which is highly elastic. The discs are thickest in the cervical region, with the exception of the one placed between the sacrum and the last lumbar vertebra. They are ossified in the sacrum, and bi-concave in the coccygeal region.

The **superior common ligament** is situated upon the floor of the spinal canal, extending from the axis to the sacrum. It is peculiar in being broad above the inter-vertebral discs to which it is adherent, and narrow as it passes along the bodies of the vertebræ.

The **inferior common ligament** is situated along the inferior spines of the vertebræ, arising from the ninth dorsal and continued to the sacrum.

The **arches** are bound together by means of the inter-lamellar or ligamenta subflava attached to the posterior border of one lamina and the anterior margin of the one behind it. It is composed of two layers of yellow elastic

tissue in the cervical region, and white fibrous tissue in all the regions posteriorly to it, and becomes continuous with the capsular ligament of the articular processes.

The **articular** or **oblique processes,** four in number, are covered by capsular ligaments, which are lined by synovial membranes. Structure—white fibrous tissue in all regions but the cervical, which is yellow elastic tissue.

The **spinous processes** are bound together by means of the supra and inter spinous ligaments, also by the ligamentum nuchæ in the cervical region.

The **inter-spinous ligaments** are situated between the superior spines of the vertebræ, attached anteriorly to the posterior border of one spine, and to the anterior border of the one behind it; they are composed of two layers of white fibrous tissue in all regions but the cervical, which is yellow elastic tissue. They become blended with the supra spinous ligament, and inferiorly with the inter-lamellar.

The **supra spinous ligament** is situated along the upper aspect of the superior spines, from the occiput to the sacrum; it is divided into two portions—an anterior, called the *ligamentum nuchæ*, composed of yellow elastic tissue, and a posterior or dorso-lumbar portion made up of white fibrous tissue.

The **ligamentum nuchæ** *(plate* 1, *f)*, is divided into two parts—a superior, cord-like, **funicular,** attached anteriorly to the cervical tuberosity of the occiput; posteriorly to the superior spines of the fifth and sixth dorsal vertebræ. The inferior portion, **lamellar,** consists of two flattened layers applied to each other with a thin layer of fat intervening, attached superiorly to the inferior surface of the funicular portion, and inferiorly to the superior spines of the last six cervical and first four dorsal vertebræ.

LIGAMENTS OF THE RIBS.

The heads of the ribs are attached by **inter-articular**

ligaments, which are inserted in the notches in the articulatory head, run through the vertebral canal, and join their fellows on the opposite side. Other small ligaments run from the heads to the transverse processes. Each of the true ribs has a synovial articulation with the *sternum*, and the joint so formed is closely bound with small ligaments. The cartilages of the false ribs owe their connection to a firm band of yellow elastic ligament. Ligament clothes the bones and cartilages forming the sternum.

LIGAMENTS OF THE FORE-LEG.

Shoulder Joint.—There is only one ligament connecting the *scapula* with the *humerus*, viz.: the *capsular*, situated around the head of the latter, and encircling the glenoid cavity of the former. The strength of this ligament is greatly enhanced by the influence of atmospheric pressure, which effectually prevents the separation of the bones so long as the ligament is uninjured. When the joint is carefully dissected so as not to prick the capsular ligament the bones remain in firm apposition, but if the scapula is held in one hand and the capsula pricked, the humerus drops.

ELBOW JOINT.

Three ligaments enter into the composition of the joints formed by the *humerus*, *radius*, and *ulna*. The **external lateral,** which is attached above to the postero lateral part of the external condyle of the humerus and the ridge running therefrom to the supero-external tuberosity of the radius. The **internal-lateral** from a tuberosity on the internal condyle of the humerus, to the inner side of the upper third of the radius, and the **capsular ligament,** which exists in front of the joint.

Between the *radius* and *ulna* are interosseous ligaments making the connection very strong; transverse fibres also

run from each side of the *ulna* to the posterior surface of the *radius*.

THE KNEE JOINT.

This consists of four distinct joints, all synovial, and having distinct capsular ligaments. The connections between each of the bones are numerous, but four are common to the whole knee, viz.: one **anterior**, two **lateral**, and one **posterior**.

The **internal lateral** extends from the *internal tuberosity* of the *radius*, is attached to the *scaphoid*, *trapezoid*, and *magnum*, and inserted to the inner side of the large and the inner small metacarpal bones.

The **external lateral** consists of two bundles, the fibres of which cross each other; it is attached to the *external tuberosity* of the *radius*, the *unciform*, and is inserted on the head of the external small metacarpal.

The **anterior ligament** extends over the whole of the anterior part of the knee, is attached to the end of the *radius* superiorly; laterally it is blended with the lateral ligaments.

The **posterior ligament** covers the posterior surface of the knee, and is attached to all the knee bones except the pisiform. In addition the small bones of the carpus in each row are united by ligaments attached to the anterior surface of each, and some interposed ones having their insertion in the fossæ between the articulatory faces; these are called *interosseous*. The upper row is united to the lower by ligaments situated on the posterior surface, one from the *scaphoid* to the *trapezoid* and *magnum*, one from the *cuneiform* to the *magnum*, another from the *pisiform* to the *unciform*. Similar small ligaments bind the lower row of bones to the metacarpal bone, two anterior and two posterior.

The **fetlock joint** is the union of the inferior extremity of the *canon bone* superiorly with the two *sesamoids* and

the *os suffraginis* or *pastern bone*. Some of the ligaments about this joint belong solely to the pastern and sesamoid bones, whilst others connect each of these with the metacarpal.

Those belonging to the pastern and sesamoid solely are six—the *inter-sesamoid*, two *lateral*, three *inferior*.

The **inter-sesamoid** unites the two sesamoid bones, is fibro-cartilaginous, and forms a grooved pad, furnished with synovial membrane, over which the flexor tendons play.

The **lateral sesamoid,** two in number, bind the sesamoid bones to the head of the *os suffraginis*; they are also called the **crucial ligaments.**

The ligaments connecting the sesamoid and pastern bones with the metacarpal are four—two *lateral*, *anterior* or *capsular*, and *posterior* or *suspensory*.

The **internal and external lateral ligaments,** situated on either side of the joint, are each composed of two bundles, the one superficial, which may be distinctly traced beneath the skin, runs down to the head of the os suffraginis. The deeper portion is inserted into a depression in the side of the lower head of the metacarpal, on the head of the pastern and sides of the sesamoids.

The **anterior or capsular ligament** covers the fronts of the joints, is inserted into the margin of the inferior articulatory surface of the metacarpal bone, and that of the upper end of the pastern, and blends with the lateral ligaments on each side. It is thick, and has the tendons of the extensor pedis and suffraginis attached to it.

The **posterior or suspensory ligament** is distinctly to be felt in the living horse, immediately behind the "back sinews." It is a thick, broad, flat ligament, situated at the back of the metacarpal, and occupying the space between the two splint bones. It is attached superiorly to the heads of the large and small metacarpals. About

the lower third of the large metacarpal it divides, one part running to each sesamoid. A slip then continues downwards and forwards, becoming attached to the tendon of the extensor pedis, binding that tendon to the bone about the middle third of the anterior part of the os suffraginis.

FIRST INTER-PHALANGEAL ARTICULATION.

PASTERN JOINT.

In this joint, which connects the *os suffraginis* with the *os coronæ*, there are three ligaments, the **posterior** and two **lateral.** The posterior border of the superior articulatory surface of the os coronæ is supplied with a thick margin of fibro-cartilage, extending upwards and adapted to the condyles of the pastern, and to this is attached the **posterior ligament,** which consists of six bands, two pairs of which go to the lower end of the os suffraginis, the remaining two bands extending as far as the posterior borders of that bone, about its middle. The **lateral ligaments** are attached superiorly to the *fossæ*, on the sides of the *condyles* of the *os suffraginis*, and run downwards and backwards to the sides of the *os coronæ*. Each has a slip attached to the tendon of the extensor pedis; it unites with the *posterior ligament*, and a portion runs to the *navicular bone.*

The place of a *capsular ligament* to this joint is supplied anteriorly, by the spreading of the *extensor pedis tendon*; posteriorly the synovial membrane is protected by the fibro-cartilaginous ridge to the *os coronæ*, and by the *posterior ligament.*

SECOND INTER-PHALANGEAL ARTICULATION.

The joint between the small pastern and the bones of the foot, *os coronæ*, *os pedis*, and *os naviculare.*

The ligaments of the joints formed by these three bones are five in number—the **interosseus**, one pair of **posterior**, and one pair of **lateral**.

The **interosseus** attaches the navicular bone by its anterior border to the posterior border of the *os pedis*.

The **anterior lateral ligaments** are attached to the rough portion on the sides of the *os coronæ*, and two *fossæ* at the base of the *coronal process* of the *os pedis*, also to the lateral cartilages.

The **posterior lateral** ligaments suspend as it were the *navicular* bone; two bundles of fibres converge to form a single ligament, which is inserted in the end of that bone on either side. One of the bundles is derived from the lateral ligament of the joint between the large and small pasterns; the other is attached to the *os coronæ*.

In addition to these ligaments the joint is strengthened by an expansion of the *extensor pedis* tendon in front and that of the *flexor pedis* behind.

ARTICULATIONS OF THE HIND LIMB.

LIGAMENTS OF THE PELVIS.

The ligaments connecting the sacrum with the ilium are four in number—the *interosseus*, *superior* and *inferior ilio-sacral*, and the *sacro-sciatic*.

The **interosseus**, short, and as its name expresses, binding the bones together.

The **superior ilio-sacral ligament** runs from the internal angle of the ilium to the spine of the sacrum.

The **inferior ilio-sacral ligament** runs from the internal angle and posterior border of the ilium upwards and backwards to the supra-spinous ligament on the sacral spines.

The **sacro-sciatic ligament**, broad and expanded, attached superiorly to the side of the sacrum, inferiorly to the

posterior border of the ilium and the tuberosity of the ischium, filling up the triangular space formed by the sacrum, ilium, and ischium, and serving to protect the important organs contained therein. The sciatic nerves run along its external surface, and it is pierced for the passage of blood vessels, nerves and muscles.

HIP JOINT.

This joint is formed by the head of the femur and the acetabulum, maintained in apposition by ligamentum. Three ligaments belong to the articulation : *capsular*, *pubio-femoral* and *round*.

The **capsular** ligament is attached round the neck of the femur, and the fibro-cartilage around the acetabulum ; it encloses the joint.

The **round ligament**, or **ligamentum teres**, is attached to the fossa at the bottom of the acetabulum, and that on the head of the femur.

The **pubio-femoral** runs from the symphysis (as the junction of the two pelvic bones is called) outwards under the pubis, pierces the notch in the acetabulum, and is inserted with the round ligament into the head of the femur.

STIFLE JOINT.

Corresponds to the knee of the human subject ; the *patella*, *tibia*, and *femur* assist to form it. It has nine ligaments, four belonging to the patella, and five binding the femur to the tibia.

The ligaments of the patella are the *internal*, *external*, *median*, and *capsular*. The three former are all attached to the anterior parts of the head of the tibia, and to the lateral and inferior surface of the patella. Their names indicate their relative positions. The **capsular** is attached along the superior and lateral borders of the smooth

articulatory surface continuous with the condyles of the femur, and to the borders of the patella. It is strengthened laterally by two fibrous bands, the outer one being the stronger of the two.

The patella is held in its position above by muscles.

The ligaments of the femur and tibia are two *lateral*, one *posterior* and two *crucial*.

The two **lateral**, external and internal, are attached to the condyles of the femur and the head of the tibia on either side, the internal being the longer of the two.

The **posterior** encircles the condyles of the femur, and is inserted on the lateral ligaments, the posterior border of the tibia and the semi-lunar cartilages acting the part of capsular ligament.

The **crucial** or **interosseous** are inserted in the notch, between the condyles and the head of the tibia; one goes in a direction downwards, forwards, and outwards; the other downwards, backwards, and inwards, crossing each other in their passage. The anterior is attached to the summit of the spine of the tibia, the posterior to a small tubercle on the postero-external part of the head of that bone.

HOCK JOINT.

The **hock joint** is composed of a number of articulations. Between the tibia and astragalus are seven ligaments—*anterior*, *posterior*, two *external*, and three *internal*.

The **anterior** acts the part of capsular ligament to the joint, and is attached to the borders of the articulatory surface of the tibia above, and the bones of the hock below.

The **external lateral ligaments** are called *superficial* and *deep*.

The **superficial** is the longest, and is attached to the external part of the lower end of the tibia above, and to

the astragalus, calcis, cuboid, large and small metatarsal bones below.

The **deep** external ligament is shorter, has a similar attachment superiorly, runs downwards and backwards, crossing the superficial, and is inserted in the external part of the astragalus and os calcis.

The **internal lateral ligaments** are *superficial*, *median*, and *deep*.

The **superficial** is attached to the internal end of the tibia, and to all the bones inside of the hock.

The **median** has the same origin superiorly as the superficial, and is inserted in the internal part of the astragalus and os calcis.

The **deep** is a small ligament between the tibia and astragalus. The first row of bones in the hock is composed of the *astragalus* and *os calcis;* four ligaments unite them: two lateral, the superior running from the margin of the pulley of the astragalus to the calcis, and the interosseous attached to all the rough non-articulatory spaces between the bones.

The lower row consists of the *cuboid* and three *cuneiform* bones, and there are six ligaments connecting them—two *anterior* from the cuboid to the *cuneiform magnum* and *medium*, two *interosseous* between the same bones, and two more *interosseous* connecting the *cuneiform* bones. The two rows are bound together almost entirely by ligaments which are common to the whole tarsus; the only one proper to the articulation itself being the *interosseous*.

The **interosseous** ligament is inserted superiorly between the *astragalus* and *os calcis;* inferiorly between the *cuboid* and the *cuneiform magnum*. The remaining ligaments are the two **superficial lateral ligaments** of the *tibia* and *hock*. The **posterior tarsal**, called also the calcaneo-cuboid ligament, running from the posterior border of the *os calcis* to the cuboid and external *metacarpal* bones; the **posterior**

tarso-metatarsal ligament, which binds together all the *tarsal* and the three *metatarsal* bones. This ligament is sheathed posteriorly with synovial membrane, which lines the passage for the perforans tendon. It is joined inferiorly to the suspensory ligament.

There is a fifth ligament in front of the joint, called the **astragalo-metatarsal**, which runs from a tubercle on the inner side of the astragalus, forwards and inwards to the *cuneiform medium*, *magnum*, and *large metatarsal bones*.

The ligaments attaching the lower row to the metatarsal bones have all been described as common to the hock, with the exception of the interosseous, which is divided into three bundles, one running from the cuneiform magnum, the other two on either side from the junction of the bones.

INTER-PHALANGEAL ARTICULATIONS.

These articulations are similar in construction to those of the inter-metacarpal joints of the anterior extremities.

METATARSO-PHALANGEAL ARTICULATIONS.

These joints are also similar in construction to those of the metacarpo-phalangeal articulations of the anterior extremities.

FIRST INTER-PHALANGEAL ARTICULATION.

This joint is also similar in construction to those of the anterior extremities.

SECOND INTER-PHALANGEAL ARTICULATION.

This joint is also similar in construction to those of the anterior extremities.

ANIMAL TISSUES.

Besides the tissues that enter into the formation of moveable joints, there are others which it is desirable to bring under notice.

Areolar Tissue, called also, from its universal application, *connective tissue*, is that thin white tissue which connects the skin with the flesh beneath, and the fibres of muscles together. Its areolated structure is proved by the facility with which air insinuates itself, as in some cases where the atmosphere has been allowed to get into a wound. It secretes a fluid by which it is lubricated; is vascular but insensible.

Fibrous tissue, which composes all ligaments and tendons, is of two kinds :—

1.—**White inelastic tissue,** consisting of threads placed parallel to each other like a skein of silk, and loosely connected by areolar tissue. It is but slightly vascular and sensitive during health, but its unyielding nature gives rise to great pain under inflammation.

2.—**Yellow elastic tissue** made of finer fibres, with sharp distinct margins, having a tendency to divide transversely. They split up into smaller threads which curl back on themselves like celery dressed for the table. It possesses the valuable property of elasticity. It is nearly as elastic as india-rubber, and regains this property on being moistened, although dried up for months. It enters into the composition of those ligaments which are most yielding, *e. g.: ligamentum nuchæ (plate* 1, *f*); it also enters into the composition of *fascia*, a substance which binds down muscles, and is much diffused throughout

the body, being met with in the skin, blood vessels, and trachea; it is slightly vascular and decidedly insensible.

Adipose tissue, or fat, is contained abundantly in the meshes of the areolar tissue. It acts the mechanical part of a cushion in some instances, as at the back of the orbit for the eyeball to rest against, and it is stored in various parts of the body as a reserve, for the purpose of supplying animal heat when a proper amount of nutriment is withheld. It differs in constitution in different parts of the body, that of the abdomen being firm, and that within the bones (the marrow) of a more oily nature.

Muscular tissue is the active agent of locomotion, and forms that portion of the walls of the hollow viscera by which they are endowed with the property of mobility; it is also highly organized and characterised by its power of contractility. It is of two kinds — the *voluntary* and *involuntary* — each of which differs somewhat from the other in its chemical and anatomical properties.

Voluntary tissue is of a red colour, and consists of fibres collected into bundles of different sizes, and separated from each other by a covering of fibrous tissue. These bundles or muscles are arranged so as to form groups, which, by acting harmoniously together, produce the various movements of the animal machine. The muscles are attached to the bones through the medium of white fibrous tissue, which so varies in the manner of its arrangement as to form broad or rounded tendons. Every muscle has, at least, two points of attachment—one of which is called the *origin*, from being more fixed than the other point, which is termed the *insertion*. The fibres of voluntary muscles vary in thickness in different animals, but on an average they measure about $\frac{1}{400}$ of an inch in diameter. Each fibre is composed of a number of fibrillæ bound together by a delicate sheath; each fibrilla is composed of a row of cells which are peculiar in having a

dark centre and a bright circumference. From the arrangement of these cells a fibre presents transversely a striped appearance, which character has procured for it the name of striated muscular tissue. The fibres are packed together by areolar tissue, which forms the matrix for the distribution of the nerves and blood vessels. Muscles assume different shapes—as *penniform*, having the tendon in the centre; *semi-penniform*, with the tendon on one side; *biventral* or *digastric*, having two bellies connected by a short tendon; and *bicipital* or *tricipital*, having two or three heads. They are also named according to their form, or after their course, or from their uses — as *flexors*, *extensors*, *abductors*, *adductors*, *&c.* Groups of muscles are bound down to the bony elements by fibrous membranes termed *fascia* or *aponeurosis*, which, however, allow perfect freedom of movement to the individual elements of the group. When the tendons of muscles play over bones or other prominent parts there is interposed between them a sac, *bursa mucosa*, containing a small quantity of fluid which facilitates their gliding. These bursæ are similar in structure to synovial membranes.

Involuntary muscular tissue constitutes what are termed the muscles of organic life. It is arranged in layers around such parts as the digestive tube, respiratory passages, the circulatory and urinary organs, also around such ducts as the ureters and vasa differentia, and lastly it is found in the skin, connected with the hair follicles. This variety of muscular tissue consists of pale flat unstriped bands, having an average diameter of about $\frac{1}{2500}$ of an inch, composed of oval nucleated cells and granules, which give them a bulging appearance at their centre; they vary in length in different parts according to the size of the cavity they surround. In some parts of the body—as the heart and upper part of œsophagus—this tissue is more or less striated, and of a red colour, an appearance which is best seen in the œsophagus of ruminants.

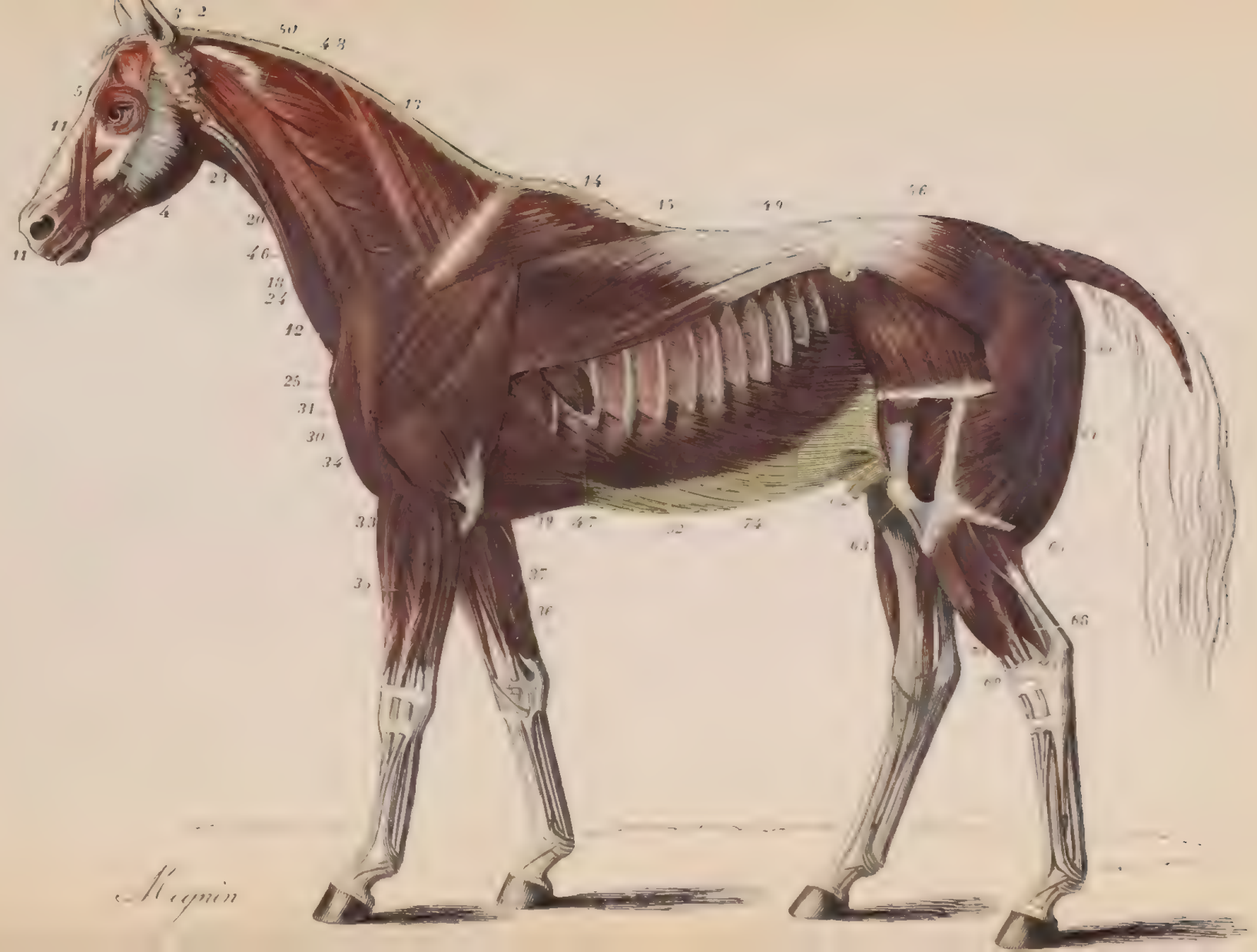
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PLATE 2.—SUPERFICIAL LAYER OF MUSCLES, the Panniculus being removed.

2. Depressor muscle of the ear.
3. Auricularis, or motor muscle of the ear.
4. Masseter.
5. Orbicularis of the eyelid.
11. Muscles of the lips and nose.
12. Levator humeri.
13. Cervical trapezius.
14. Dorsal trapezius.
15. Latissimus dorsi.
18. Pectoralis parvus.
19. Pectoralis magnus.
20. Sterno-maxillaris.
23. Subscapulo-hyoideus.
24. Antea-spinatus.
25. Postea-spinatus.
30, 31. Triceps extensor brachii.
33. Extensor metacarpi magnus.
34. Flexor brachii.
35. Extensor pedis.
36. Flexor metacarpi externus.
37. Extensor suffraginis.
46. Rhomboideus anterior.
47. Serratus magnus.
48. Levator humeri.
49. Serratus parvus.
50. Splenius.
52. Intercostal muscles.
54. Fascia lata.
55. Gluteus externus.
56. Gluteus medius.
61. Semitendinosus.
62. Rectus femoris.
63. Vastus externus.
65. Gastrocnemii.
68. Deep flexor of the phalanges.
69. Lateral extensor of the phalanges.
70. Anterior extensor of the phalanges.
71. Obliquus abdominis.

MUSCULAR SYSTEM.

In studying the muscles individually, it is most advantageous to describe them as they are found from without inwards in the different regions in the body. *(See plate* 2 *and description).*

SUBCUTANEOUS REGION.

(ONE MUSCLE.)

[Explanation of contractions :—SIT.—Situation. FIG.—Figure. ATT.—Attachments. REL.—Relations. ACT.—Action.]

Panniculus carnosus. SIT. — upon the head, neck, thorax, and abdomen. ATT.—from the angle of lower jaw, ligamentum nuchæ, cariniform cartilage of sternum, the anterior part of stifle joint, and the muscles which it covers, externally to the skin. REL.—to the dorsal trapezius, latissimus dorsi, serratus magnus, intercostals, sterno-maxillaris, jugular and spur veins, masseter, and externally the skin. ACT.—to corrugate the skin, and shake off dust, flies, or other foreign bodies.

TUNICA ABDOMINALIS.

The **tunica abdominalis** is a broad expansion of yellow elastic tissue covering the infero-lateral aspects of the abdomen. It is related externally to the panniculus, internally to the external oblique and pectoralis magnus. This tunic becomes greatly developed in the mare during pregnancy. At the point of junction of the tendinous expansion in the centre of the abdomen a distinct line is formed, running from the ensiform cartilage to the symphysis pubis ; this is called the *linea alba.*

ABDOMINAL REGION.

(FOUR MUSCLES.)

This region is arranged in four layers :—

First Layer.—**Obliquus abdominis** or **external oblique** (*plate* 2, *no.* 74). SIT.—upon inferior and lateral parts of abdomen. FIG.—quadrilateral. ATT.—composed of a muscular and tendinous portion. The muscular portion covers the lower third of the last thirteen ribs, and is serrated at its edge for attachment to them; the four anterior serrations digitating with the serratus magnus; it is also attached to the external angle of the ilium. The tendinous portion extends to the linea alba and symphysis pubis. REL.—externally, to tunica abdominalis and pectoralis magnus; internally, to the ribs, costal muscles, internal oblique, and rectus abdominis; anteriorly, to the last four digitations of serratus magnus.

The following condensed portions of, and openings through, this expansion have received special names. :—

Poupart's Ligament.—This is a strong fibrous band formed by the posterior portion of the external oblique tendon; it runs from the external angle of the ilium to the anterior border of the pubis. It forms the anterior border of a triangular space called the *femoral* or *crural arch.* Through this arch the femoral vessels leave the abdomen.

Inguinal Canal.—This is the passage for the spermatic cord in the male, and is about two inches in length.

The *External Abdominal Ring* is simply a hole through the tendinous expansion of the external oblique, having thickened edges.

The *Internal Abdominal Ring* is an opening formed by Poupart's ligament and the fleshy portion of the internal oblique. A fold of the external abdominal tendon is sent down from the symphysis to the fascia covering the thigh.

Second Layer.—**Internal Oblique** (*plate* 3, *no.* 29).

SIT.—infero-lateral part of abdomen. ATT.—also muscular and tendinous. The muscular fibres run in fan-like form chiefly from the anterior spine of the ilium; some run backwards and downwards, others forwards and downwards to the last rib; the majority run downwards and forwards to their tendinous expansion, the fibres of which cross the external oblique, and become inserted into the linea alba. REL.—externally, to the external oblique; internally, to transversalis and rectus abdominis.

Third Layer.—**Rectus abdominis** (*plate* 3, *no.* 18). SIT. infero-central part of the abdomen. FIG.—flat and fusiform. ATT.—from the cartilages of the six posterior true ribs and that of the first one, to the symphysis and anterior border of the pubis. It joins its fellow on the opposite side by means of the linea alba, and is intersected by tendinous marks at short distances throughout its structure. REL.—externally, to pectoralis magnus, internal and external oblique muscles; internally, to transversalis abdominis.

Fourth Layer.—**Transversalis.** SIT.—Supero-lateral and inferior parts of abdomen. FIG.—quadrilateral. ATT.—A broad flat muscle, the deepest situated of the four. Its muscular portion is attached to the sternum, the cartilages of the false ribs and transverse processes of the last lumbar vertebræ. Its fibres run directly transversely, and end in the tendinous expansion which is attached to the ensiform cartilage and its fellow of the opposite side by means of the linea alba. REL.—externally, to internal oblique and rectus abdominis; internally, with the fascia of transversalis abdominis. ACT.—the actions of the abdominal muscles are to assist in the functions of micturation, defecation, and parturition; they are also accessory agents in expiration, and tend to flex the back.

The *abdominal muscles* present inferiorly three openings—one in the median line, and another on each side. The

opening, *umbilicus*, in the median line or linea alba is closed after birth, but gives passage to the umbilical cord in the fœtus; the other two, *inguinal canals*, are largest in the male. Each consists of an oblique passage situated between Poupart's ligament and the muscular portion of the internal oblique; the internal orifice, *internal abdominal ring*, is formed by the transversalis muscle and the fascia which covers it; the external abdominal ring is formed by an aperture in the aponeurosis of the external oblique muscle, the borders of which have been termed the pillars of the ring.

SUPERIOR DORSO-LUMBAR REGION.

(EIGHT MUSCLES, ARRANGED IN LAYERS.)

First Layer. — **Dorsal trapezius** (*plate* 2, *no.* 14). SIT.—lateral parts of the withers. FIG. — triangular. ATT.—arises partly by tendon, partly by fibre, from the summit of the second, extending as far back as the fourteenth, dorsal spine; *insertion* by tendon into the spine of the scapula. REL.—externally, to panniculus; internally, to rhomboideus; posteriorly, to postea spinatus and latissimus dorsi. ACT.—This muscle is very useful in drawing the scapula upwards and backwards; and, therefore, must be a powerful assistant in progression.

Latissimus dorsi (*plate* 2, *no.* 15). SIT.—lateral aspect of lumbar and costal regions. Fig. — triangular. ATT. — *origin*, by five tendons from the lumbar fascia and the supra spinal ligament, and as far forward as the third dorsal spine; *insertion* into the inner side of the humerus, by tendon which joins that of the teres internus muscle. REL. — externally, to panniculus, dorsal trapezius, and triceps extensor brachii; internally, to cartilage of scapula, rhomboideus brevis, and small serrated muscles of the

back. ACT.—to retract the humerus, and aid in bracing the muscles of the back.

Second Layer. **Rhomboideus** (*plate* 3, *no.* 12). SIT.—side of withers. FIG.—square and flattened. ATT.—*origin*, second, third, fourth, fifth, and sixth superior spines of dorsal vertebræ; *insertion*, inner surface of the cartilage of scapula. REL.—externally, to trapezius; internally, to serratus magnus. ACT.—elevates and adducts the scapula, and keeps the cartilage of the scapula close to the trunk.

Third Layer.—**Serratus magnus** or **anterior serratus** (*plate* 2, *no.* 47). SIT.—lateral aspect of dorsal spines. FIG.—quadrilateral and digitated inferiorly. ATT.—*origin*, from the anterior border of the ribs from the sixth to the twelfth; *insertion*, by tendinous expansion to the superior spinous processes of the dorsal vertebræ from the second to the thirteenth. REL.—externally, to rhomboideus brevis, latissimus dorsi; internally, to longissimus dorsi, ilio-costals, and external inter-costals. ACT.—to assist in inspiration.

Serratus parvus or **posterior small serratus** (*plate* 2, *no.* 49). SIT.—lateral aspects of dorsal spines. FIG.—quadrilateral. ATT.—*origin*, from the summit of the last eight dorsal and first three lumbar spines; *insertion*, by digitation upon the postero-external surface of the last nine ribs. REL.—externally, to latissimus dorsi and external oblique; internally, to longissimus dorsi. ACT.—expiratory muscle.

Fourth Layer. **Longissimus dorsi.** SIT.—lateral aspect of cervical, dorsal, and lumbar spines. FIG.—prismatic, and bifurcates posteriorly. ATT.—This is, posteriorly, an immense fleshy mass situated at the posterior part of the back, and on the upper surface of the lumbar vertebræ; it is the largest muscle in the horse's body; *origin*, from the transverse processes and supra-spinal ligament of the

sacral and lumbar regions, and as far forward in the dorsal as the eleventh vertebræ; also from the transverse processes of all the remaining vertebræ; *insertion* into the bottom and margin of both spines of the ilium; into the transverse processes of the lumbar vertebræ; and into the ribs, as well as into the last four, but sometimes five, cervical vertebræ. REL.—externally, to gluteus medius, small serrated muscle of the back, complexus major, serratus magnus; internally, to inter-transversalis lumborum, levatores costarum, and external inter-costals; anteriorly, to ligamentum nuchæ. ACT.—an extensor of the back; if acting singly, the anterior or posterior parts of the body will be inclined to that side; it also assists in raising the neck.

Ilio-costalis. SIT.—along the inferior border of longissimus dorsi. FIG.—elongated and flat. ATT.—*origin*, from the anterior border of the ilium, and transverse processes of the lumbar vertebræ; *insertion*, upon all the ribs a little below their tubercles, and transverse process of the seventh cervical vertebra. REL.—externally, to small serrated muscles of the back; internally, to the external intercostals. ACT.—expiratory.

Fifth Layer.—**Semi-spinalis dorsi et lumborum** (*plate* 3, *no.* 14). SIT.—lateral parts of sacrum, lumbar and dorsal spines. FIG.—elongated and flattened. ATT.—*origin*, lateral border of sacrum, articular processes of lumbar and transverse processes of dorsal spines; *insertion*, spinous processes of dorsal, lumbar, sacrum, and last cervical vertebræ. REL.—externally, to longissimus dorsi; internally, to sacral, lumbar, and dorsal spines. ACT.—an extensor of the back.

SUB-LUMBAR REGION.

(EIGHT MUSCLES.)

Psoas magnus. SIT. — sub-lumbar region. FIG.—

fusiform. ATT.—*origin*, from the heads of the three last ribs, bodies of the three last dorsal vertebræ, transverse processes and bodies of all the lumbar vertebræ; *insertion*, upon the internal trochanter of the femur. REL.—superiorly, to quadratus and transversalis lumborum; inferiorly, to pleura, diaphragm, and sartorius. ACT.—to flex and rotate the thigh; when it is fixed it flexes the loins.

Psoas parvus. SIT.—sub-lumbar region upon the inner side of psoas magnus. FIG.—semi-penniform. ATT.—*origin*, from the heads of the three last ribs, bodies of last four dorsal, and all the bodies of the lumbar vertebræ; *insertion*, into the tubercle on the brim of the pelvis. REL.—superiorly, to bodies of the vertebræ above described; inferiorly, to pleura, diaphragm, posterior aorta, and peritoneum; internally, to crura of diaphragm; externally, to psoas magnus. ACT.—To flex the pelvis upon the spine and assist in flexing the loins to one side.

Iliacus. SIT.—venter surface of ilium. FIG.—bicipital. ATT.—*origin*, by the larger head, from the anterior spinous process and the venter of the ilium. By the small head, which lies between the two psoas muscles, from the venter of the ilium. *Insertion*, by tendon, common also to the psoas magnus, into the inner trochanter of the femur. REL.—superiorly, to the ilium; inferiorly, to sartorius, psoas magnus; externally, to tensor vaginæ; internally, to femoral artery and vein. ACT.—to arch the lumbar vertebræ, and in galloping, conjointly with the abdominal muscles, to draw the pelvis forward, and to place the hind leg well under the body during violent motion.

Quadratus lumborum. SIT.—beneath the transverse processes of lumbar vertebræ. FIG.—thin and semi-circular. ATT.—*origin*, from anterior border of ilium, and transverse processes of lumbar vertebræ; *insertion*, upon posterior border of last rib. REL.—superiorly, to inter-transversalis lumborum; inferiorly, to psoas magnus. **ACT.—expiratory.**

Inter-transversales lumborum, which are four in number. SIT.—between transverse processes of lumbar vertebræ; FIG.—flattened slips. ATT.—to the anterior and posterior borders of transverse processes of lumbar vertebræ. REL. superiorly, to longissimus dorsi; inferiorly, to psoas magnus and quadratus lumborum. ACT.—when combined they flex the loins; if the muscles of one side act the loins are curved to that side.

COCCYGEAL REGION.

(FOUR MUSCLES.)

Erector coccygis (*plate* 3, *nos.* 31, 32, 33). SIT.—superior surface of sacrum and coccyx. FIG.—pyramidal. ATT.—*origin*, last four sacral spines; *insertion*, superior surface of all the coccygeal vertebræ. REL.—superiorly, to coccygeal aponeurosis; inferiorly, to coccygeal bones; internally, to its fellow upon the opposite side; externally, to curvator coccygis. ACT.—Elevates the tail and turns it to one side.

Depressor coccygis. SIT.—infero-lateral part of the tail. FIG.—pyramidal and elongated. ATT.—*origin*, inferior surface of the posterior part of sacrum and sacro-sciatic ligament; *insertion*, inferior surface of coccygeal bones. REL.—superiorly to sacrum and coccygeal bones; externally, to compressor coccygis; internally, with its fellow. ACT.—to depress and curve the tail to one side.

Curvator coccygis. SIT.—lateral surface of sacrum and coccygeal bones. FIG.—pyramidal. ATT.—*origin*, two last lumbar and lateral parts of all the sacral spines; *insertion*, lateral parts of coccyx. REL.—externally, to aponeurosis and infero-sacro-iliac ligament; internally, to the tail bones; superiorly, to erector coccygis; inferiorly, to depressor coccygis. ACT.—curves the tail to one side.

Compressor coccygis. SIT.—postero-lateral surface of sacrum. FIG.—triangular. ATT.—*origin*, from the superior

border of the os innominata; *insertion*, last sacral and first four coccygeal vertebræ. Rel.—externally, to sacro-sciatic ligament; internally, to curvator coccygis. Act.—to depress the tail.

ANAL REGION.

(FOUR MUSCLES.)

Sphincter ani encircles the opening of the anus, and enters within it for the depth of four or five inches. It has neither origin nor insertion. Act.—to close the anus.

Retractor ani inferior. Fig.—bifid posteriorly. Att.—*origin*, os innominata; *insertion* into the rectum, both heads mingling with the fibres of the sphincter ani upon the lower surface. Act.—to retract the anus, pulling it downwards after the passage of the fœces.

Retractor ani superior. Att.—*origin*, from the inferior of the sacrum; *insertion*, mingles with fibres of the sphincter ani upon their upper surface. Act.—to co-operate with the inferior retractor, pulling the anus upwards.

Levator ani consists of two slips of red muscular fibre.

Transverse perineus.—This is a small muscular band arising from the ischium, and is inserted upon the perineum.

MALE GENITAL REGION.

(FOUR MUSCLES).

Cremaster. Sit.—external aspect of spermatic cord. Fig.—an elongated band. Att.—*origin*, transversalis fascia and internal oblique muscle; *insertion*, fibrous covering of the cord. Rel.—externally, to dartos and posterior wall of inguinal canal; internally, fibrous tunic of the cord. Act.—to suspend and elevate the testicle.

Erector penis. Sit.—between the ischium and crust of penis. Fig.—conoid. Att.—*origin*, inferiorly to the inner

side of the tuberosity of the ischium; *insertion*, crus penis. Act.—to favour an influx of blood to the penis to elevate the organ, and assist in retaining its erection.

Triangularis penis. Sit.—floor of pelvis. Fig.—irregularly triangular. Att.—*origin*, inner aspect of ischium on each side; *insertion*, urethra and prostrate gland. Act.—to constrict the prostatic portion of the urethra.

Accelator urinæ. Sit.—bulb and spongy portion of urethra. Fig.—tubular. Att.—around the bulb and spongy portion of urethra. Act.—to compress the urethral canal.

FEMALE GENITAL REGION.

(THREE MUSCLES.)

Erectores clitorides. These are similar to the erectors penis in the male. Act.—to assist in erecting the clitoris.

Sphincter vaginæ. It consists of a strong band of muscular tissue surrounding the vulva and posterior part of vaginæ. Act.—to close vulva and vaginæ.

SUPERIOR CERVICAL REGION.

(SIXTEEN MUSCLES ARRANGED IN FOUR LAYERS.)

First Layer. — **Cervical trapezius** *(plate* 2, *no.* 13*)*. Sit.—postero-lateral part of neck. Fig.—triangular. Att.—*origin*, cordiform portion of ligamentum nuchæ; *insertion*, tubercle upon spine of scapula and tendon of dorsal trapezius. Rel.—externally, to aponeurosis of levator humeri; internally, to rhomboideus longus, splenius, pectoralis parvus, and antea spinatus. Act.—to draw the scapula forwards.

Second Layer.—**Rhomboideus anterior** *(plate* 2, no. 46*)*. Sit.—lateral aspect of cordiform portion of ligamentum nuchæ. Fig.—triangular. Att.—*origin*, funicular portion

of ligamentum nuchæ as far forwards as the dentata, and as far backwards as the fifth dorsal; *insertion*, anterior border and inner surface of the cartilage upon the scapula. Rel.—externally, to cervical trapezius and splenius. Act.—It aids the serratus magnus, as well as keeps the cartilage of the scapula close to the trunk.

Splenius (*plate* 2, *no.* 50). Sit.—supero-lateral part of neck. Fig.—triangular. Att.—*origin*, by fine tendon from the anterior six dorsal spines; *insertion*, into the occipital ridge by tendon, the petrous temporal bone and wing of the atlas, as well as the second, third, fourth, and fifth cervical transverse processes. Rel.—externally, to serratus magnus, cervical trapezius, and levator humeri; internally, to complexus major, trachelo-mastoideus, inter-transversalis colli, and posterior muscles of the head. Act.—one muscle contracting would draw the head to that side; both would curve the neck, and operate in rapid movements to raise the head.

Third Layer.—**Complexus major.** Sit.—supero-lateral part of neck. Fig.—triangular. Att.—*origin*, first four spines and transverse processes of dorsal and oblique processes of all the cervical vertebræ; *insertion*, upon occipital crest. Rel.—externally, to splenius, longissimus dorsi; internally, to lamellar portion of ligamentum nuchæ, rectus capitus anticus, and oblique muscles of the head. Act.—to extend and rotate the head.

Trachelo-mastoideus. Sit.—inferior border of complexus major. Fig.—fusiform. Att.—*origin*, transverse processes of the two first dorsal, and oblique processes of the last six cervical vertebræ; *insertion*, by a double tendon upon mastoid crest and wing of atlas. Rel.—externally, to splenius; internally, to complexus major and oblique muscles of head. Act.—to elevate the head, and assist in turning it to one side.

Fourth Layer.—**Semi-spinalis colli.** Sit.—lateral aspect

of supra spinous processes of cervical vertebræ. FIG.—flattened bands. ATT.—*origin*, posterior oblique processes of last five cervical vertebræ; *insertion*, upon the superior spines of second, third, fourth, fifth, and sixth cervical vertebræ. REL.—externally, to complexus major; internally, to ligamentum nuchæ. ACT.—to extend the neck, and assist in turning the head and neck to one side.

Inter-transversales colli. SIT.—lateral aspect of oblique and transverse processes of cervical vertebræ. FIG.—quadrangular, six bundles. ATT.—to anterior part of oblique and posterior border of transverse processes of cervical vertebræ. REL.—externally, to splenius, serratus magnus, scalenus, and rectus capitis anticus major; internally, to vertebral artery and vein. ACT.—to assist in turning the neck to one side.

Obliquus capitis posticus. SIT.—lateral aspect of atlas and dentata. FIG.—quadrilateral. ATT.—*origin*, lateral aspect of supra spinous process of axis; *insertion*, superior part of atlas. REL.—externally, to splenius and trachelo-mastoideus; internally, to capsular ligament of axido-atloid articulation. ACT.—to turn the axis on atlas.

Obliquus capitis anticus. SIT.—lateral aspect of occipito-atloid articulation. FIG.—nearly square. ATT.—*origin*, anterior border of atlas; *insertion*, styloid and mastoid crests of occiput. REL.—externally, to tendon of splenius and levator humeri; internally, to capsular ligament of occipito-atloid articulation. ACT.—it gives slight extension and lateral inclination to the head.

Rectus capitis posticus major (*plate* 3, *no.* 2). SIT.—supra-lateral aspect of atlas and axis. FIG.—prismatic. ATT.—*origin*, superior spinous process of axis; *insertion*, cervical tuberosity of occiput. REL.—supero-externally, to oblique muscles of the head; internally, to its fellow; inferiorly, to rectus capitis posticus minor. ACT.—To toss the head into the air, or to move the occiput upon the atlas.

Rectus capitis posticus minor. SIT.—superior part of occipito-atloid articulation. FIG.—triangular. ATT.—*origin*, superior part of atlas; *insertion*, cervical tuberosity of occiput. REL.—covered by the former muscle. ACT.—to elevate the head and to guard the capsular ligament.

INFERIOR CERVICAL REGION.

(NINE MUSCLES.)

Levator humeri *(plate 2, no. 48)*. SIT.—infero-lateral part of neck. FIG.—elongated and flat. ATT.—*origin*, mastoid process, crest of occiput, and transverse processes of the first four cervical vertebræ; *insertion*, external tuberosity and deltoid ridge of humerus, and fascia of the coraco-radialis. REL.—externally, to panniculus; internally, to splenius, trachelo-mastoideus, oblique and straight muscles of the head, scalenus, pectoralis parvus, and abductor brachii; anteriorly, to parotid gland and cervico-auricular muscles. ACT.—When the head is fixed it will draw the anterior extremity forward. When the legs are fixed one muscle contracting will pull the head to that side; both muscles acting will curve the neck downward.

Sterno-maxillaris *(plate 2, no. 20, and plate 3, no. 4)*. SIT.—inferior part of neck. FIG.—cylindrical. ATT.—*origin*, cariniform cartilage of sternum; *insertion*, posterior border of the lower jaw, and by fascia to mastoid process. REL.—externally, to panniculus; internally, to subscapulo-hyoideus, sterno-thyro-hyoideus, and sub-maxillary glands. ACT.—to flex the head and turn it on one side.

Sterno-thyro-hyoideus *(plate 3, no. 3)*. SIT.—inferior part of trachea. FIG.—digastric. ATT.—*origin*, from the cariniform process of the sternum; about the middle of the trachea the muscle becomes tendinous; from this tendon it divides into two heads; *insertion*, into the spur

process of the os hyoides by one head, and by the other head into the thyroid cartilage of the larynx. Rel.—externally, to sterno-maxillaris; internally, to trachea. Act.—to regulate the downward motions of the larynx; and to pull downward the os hyoides.

Subscapulo-hyoideus *(plate 2, no. 23)*. Sit.—inferior part of neck. Fig.—a thin elongated band. Att.—*origin*, anteriorly, by fibre, from the spur process of the hyoides; *insertion*, posteriorly, by fine tendon to the inner side of the shoulder. Rel.—externally, to subscapularis, pectoralis parvus, and levator humeri; internally, to scalenus, rectus capitis anticus major, recurrent, sympathetic, and pneumo-gastric nerves, and carotid artery. Act. — to draw the os hyoides downwards, and to a slight extent aid in pulling the shoulder forward. The muscle passes between and over important parts, dividing the jugular veins from the carotid artery; and covering the par vagum, sympathetic, recurrents, and phrenic nerves, besides lymphatics and conglomerate glands.

Rectus capitis anticus major *(plate 3, no. 2)*. Sit.—antero-lateral part of neck. Fig.—pyramidal. Att.—*origin*, from all the transverse processes of cervical vertebræ except first and last; *insertion*, basilar process of occiput. Rel.—externally, to scalenus, levator humeri, subscapulo-hyoideus and carotid artery; internally, to longus colli; superiorly, to capsular ligament of the occipito-atloid articulation. Act.—to flex and rotate the head.

Rectus capitis anticus minor. Sit. — beneath the occipito-atloid articulation. Fig. — prismatic. Att. — *origin*, lower surface of atlas; *insertion*, basilar process of occiput. Rel.—externally, to guttural pouch; superiorly, to capsular ligament of occipito-atloid joint. Act.—to flex the head.

Rectus capitis lateralis. Sit.—lateral aspect of occipito-atloid articulation. Fig.—prismatic. Att.—*origin*, in-

ferior part of atlas; *insertion*, styloid process of occiput. Rel.—same as former muscle. Act.—to flex the head.

Scalenus (*plate* 3, *no.* 6). Sit.—infero-lateral part of neck. Fig.—triangular and of two parts. Att.—*origin*, transverse processes of fourth, fifth, sixth, and seventh cervical vertebræ; *insertion*, anterior border of first rib, about its middle. Rel. — externally, to subscapulo-hyoideus, levator humeri, and pectoralis parvus; internally, to longus colli. Act.—inspiratory, and when the ribs are fixed will tend to draw the neck to one side.

Longus colli (*plate* 3, *no.* 10). Sit. — inferior surfaces of all the cervical vertebræ. Fig.—enlarged in the centre and tapering towards its extremities. Att.—*origin*, inferior surfaces of first six dorsal vertebræ; *insertion*, transverse processes of the last six cervical vertebræ and all the inferior spines of the same region. Rel.—inferiorly, to trachea and œsophagus; superiorly, to the vertebræ above mentioned; laterally, to pleura, scalenus, rectus capitis anticus major, and vertebral artery. Act.—a flexor of the neck.

STERNO-BRACHIAL REGION.

(four muscles.)

Sterno-aponeuroticus. Sit.—the space between sternum and fore-arm. Fig.—quadrilateral. Att.—*origin*, inferior surface of sternum; *insertion*, upon fascia of fore-arm. Rel.—anteriorly, to levator humeri and skin; internally, to pectoralis magnus and parvus. Act.—to adduct the fore-arm.

Sterno-humeralis. Sit.—in the space between sternum and arm. Fig.—flattened and irregular. Att.—*origin*, cariniform cartilage and inferior surface of sternum; *insertion*, external tuberosity of humerus. Rel.—externally, to panniculus and skin; internally, to sterno-

aponeuroticus and pectoralis parvus. ACT.—to adduct the arm.

Pectoralis magnus (*plate* 2, *no.* 19). SIT.—postero-inferior aspect of sternum. FIG.—prismatic anteriorly, and flattened posteriorly. ATT.—*origin*, tunica abdominalis, tendon of external oblique muscle of the abdomen, cartilages of false ribs, and inferior surface of the three last segments of sternum; *insertion*, internal tubercle upon head of humerus. REL.—externally, to sterno-aponeuroticus and sterno-humeralis; internally, to external oblique muscle of the abdomen, serratus magnus, and pectoralis parvus. ACT.—to flex and adduct the arm.

Pectoralis parvus (*plate* 2, *no.* 18). SIT.—antero-lateral part of the thorax. FIG.—prismatic. ATT.—*origin*, lateral aspect of first three segments of sternum, and cartilage of first four ribs; *insertion*, anterior border of scapula and fascia of antea-spinatus muscle. REL.—externally, to pectoralis magnus, sterno-aponeuroticus, levator humeri, and cervical trapezius; internally to lateralis sterni, intercostals, to serratus magnus, and scalenus. ACT.—to draw the shoulder back; or, the leg being fixed, to pull the body forward.

COSTAL REGION.

(FIFTY-FOUR MUSCLES.)

Serratus magnus (*plate* 2, *no.* 47). SIT.—lateral part of thorax and posterior portion of neck. FIG.—fan shaped. ATT.—*origin*, transverse process of last five cervical vertebræ, and outer surface of true ribs; *insertion*, the roughened surface of venter scapulæ. REL.—externally, to subscapularis, teres internus, triceps extensor brachii, levator humeri and pectoralis parvus; internally, to the first seven external inter-costals and small serrated muscles of the back; antero-internally, to splenius, trachleo-

mastoideus, and longissimus dorsi. ACT.—to bind the fore limb to the trunk, and form a centre for the rotation of the scapula; when the shoulder is fixed it acts as an inspiratory muscle.

Lateralis sterni (sterno costalis). SIT.—antero-lateral part of sternum. FIG.—elongated. ATT.—*origin*, fourth and fifth costal cartilages, near the sternum; *insertion*, outer surface of first rib. REL.—externally, to pectoral muscles; internally, to external inter-costals. ACT.—to depress the ribs and thus assist in expiration.

External inter-costals (*plate* 2, *no.* 52, *also plate* 3, *no.* 16), seventeen in number. SIT.—between the ribs. FIG.—flattened bundles. ATT.—*origin*, posterior border of ribs; *insertion*, antero-external border of ribs; the fibres are directed from above downwards and backwards. REL.—externally, to serratus magnus, pectoral muscles, external oblique of abdomen, and lateralis sterni; internally, to the internal inter-costals. ACT.—inspiratory.

Levatores costarum (*plate* 3, *no.* 13), seventeen in number. SIT.—between transverse processes of dorsal vertebræ and ribs. FIG.—triangular. ATT.—*origin*, transverse processes of dorsal vertebræ; *insertion*, antero-external surface of ribs a little beneath their head. REL.—externally, to longissimus dorsi; internally, to the internal inter-costals. ACT.—to elevate the ribs and thus assist in inspiration.

Internal inter-costals (*plate* 3, *no.* 16), seventeen in number. SIT.—between the ribs. FIG.—flattened bundles. ATT.—*origin*, from posterior border of rib; *insertion*, anterior border of rib behind; the fibres are directed from above downwards and forwards. REL.—externally, to the external inter-costals; internally, to the pleuræ. ACT.—an expiratory muscle.

Triangularis sterni. SIT.—superior surface of sternum; FIG.—triangular. ATT.—*origin*, superior surface of

sternum; *insertion*, inner aspect of the last seven cartilages of true ribs. REL.—superiorly, to pleura; inferiorly, to sternum, costal cartilages, and thoracic artery and vein; interally, to the inter-costals. ACT. — an expiratory muscle.

DIAPHRAGMATIC REGION.

(ONE MUSCLE.)

The **diaphragm** is a very important muscle, and, like the heart, is, during life, in constant action. SIT.—between the thoracic and abdominal cavities. FIG.—circular, and flattened from before backwards; its anterior surface concave, posterior convex, and bifid superiorly. ATT.—*origin*, by two crura, a right and left—the former from the bodies of all the lumbar vertebræ, the latter from the first four bodies of the lumbar vertebræ; *insertion*, inferior extremities of last eleven ribs and ensiform cartilage of sternum. This muscle is formed of two parts, a central portion, *tendinous*, and a circumferential, *muscular*. It is perforated by three foraminæ:—*hiatus aorticus*, which is situated superiorly, gives passage to the posterior aorta, vena azygos and thoracic duct; a little below this and towards the left side is the *foramen sinistrum* or œsophageal, which gives passage to the œsophagus, pneumogastric nerves and œsophageal arteries; below this and towards the right side is the *foramen dextrum*, which gives passage to the posterior vena cava. REL.—anteriorly, to pleuræ; posteriorly, to peritoneum. ACT.—inspiratory; by the contraction of its muscular portion the abdominal cavity is diminished and the capacity of the thorax enlarged, and when fixed assists in the actions of defecation, micturation, and parturition.

MUSCLES OF THE HEAD.

THE AURICULAR REGION.

(TEN MUSCLES.)

Zygomatico-auricularis. SIT.—anterior part of ear. FIG.—triangular and bifurcated. ATT.—*origin*, zygomatic process of temporal bone; *insertion*, external surface of scutiform and conchal cartilages. REL.—externally, to the skin; internally, to temporalis and parotid gland. ACT.—to rotate and elevate the ear forwards.

Temporo-auricularis externus (*plate* 2, *no.* 3). SIT.—parietal region. FIG.—fan shape. ATT.—*origin*, from parietal crest; *insertion*, internal border of scutiform, and inner surface of conchal cartilages. REL.—externally, to the skin; internally, to the temporalis. ACT.—to adduct and direct the ear forwards.

Temporo-auricularis internus. SIT.—behind the former muscle. FIG.—triangular. ATT.—*origin*, parietal ridge of occiput; *insertion*, internal aspect of conchal cartilage. REL.—externally, to the former muscle; internally, to temporalis muscle, and conchal cartilage. ACT.—adducts the ear.

Scuto-auricularis externus. SIT.—behind scutiform and conchal cartilages. FIG.—quadrilateral. ATT.—*origin*, external surface of scutiform cartilage; *insertion*, internal surface of conchal cartilage. REL.—externally, to temporo-auricularis externus; internally, to scuto-auricularis internus. ACT.—to rotate the concha inwards.

Cervico-auricular muscles, three in number—a *superior*, *median*, and *internal*, which may be considered as one muscle. SIT.—behind the ear and lateral aspect of poll. FIG.—quadrilateral. ATT.—*origin*, cordiform portion of ligamentum nuchæ; *insertion*, postero-external surface of concha. REL.—externally, to the skin; internally, to

tendon of levator humeri and parotid gland. ACT.—to direct the ear backwards and outwards.

Parotido-auricularis. SIT.—outer surface of parotid gland. FIG. -triangular. ATT.—*origin*, outer surface of parotid gland ; *insertion*, external part of concha. REL.—externally, to panniculus ; internally, to parotid gland. ACT.—to abduct the ear.

Scuto-auricularis internus (*plate* 2, *no.* 2). SIT.—inner aspect of lower part of ear. FIG. formed of two bands, crucial. ATT. *origin*, inferior surface of scutiform cartilage ; *insertion*, posterior part of concha. REL.—externally, to scuto-auricularis externus ; internally, to temporalis. ACT.—to rotate the ear outwards and backwards.

Mastoido-auricularis. SIT. -inner aspect of the base of concha. FIG. - quadrilateral. ATT. — *origin*, external auditory process ; *insertion*, base of concha. REL. — externally, to temporo-auricularis ; internally, to auricular cartilage. ACT.- -to draw the concha forwards and shorten the tube of the external ear.

FACIAL REGION.

(THIRTEEN MUSCLES).

Orbicularis Oris (*plate* 2, *no.* 11). SIT.—round the lips. FIG.—oval, perforated in the centre. ATT.—its fibres interlace with each other and adhere close to the skin, and mucous membrane of the mouth. REL.—externally, to skin ; internally, to mucous membrane of the lips. ACT.—to close the lips and thus assist in the various movements of suction and prehension.

Alveolo-labialis or **Buccinator.** SIT.—external aspect of molar teeth. FIG. — elongated and flattened. ATT.—*origin*, alveolar tuberosity of superior maxillary bone near the first molar tooth ; *insertion*, its fibres become blended

with those of the orbicularis oris. Rel. —externally, to dilator naris lateralis, levator labii superioris, zygomaticus and masseter muscles; it is pierced near its centre by Steno's duct; internally, to buccal mucous membrane and molar glands. Act.—to assist in mastication by preventing the food lodging between the buccal membrane and molar teeth.

Zygomaticus. Sit.—lateral aspect of face. Fig.—a thin flattened band. Att. — *origin*, fascia covering masseter; *insertion*, angle of mouth. Rel.—externally, to skin; internally, to masseter, alveolo-labialis, and facial artery. Act.—to retract the angle of the mouth.

Levator labii superioris alaque nasi. Sit.—supero-lateral aspect of face. Fig. — quadrilateral and bifid anteriorly. Att.—*origin*, external surface of frontal and nasal bones near the mesian line; *insertion*, by one portion upon the external alæ of the nose, and by the other to the angle of the mouth. Rel.—externally, to skin, dilator naris lateralis; internally, to nasalis longus labii superioris. Act.—to retract the angle of the mouth and dilate the nostril, at the same time assist in elevating the upper lip.

Dilator naris lateralis. Sit.—lateral aspect of face. Fig.—triangular. Att.—*origin*, anterior part of zygoma; *insertion*, external alæ nasi. Rel.—externally, to nasalis longus labii superioris and skin; internally, to pes anserinus and superior labial artery. Act.—to dilate the nostril.

Nasalis longus labii superioris. Sit.—supero-lateral aspect of face. Fig. — pyramidal. Att. — *origin*, outer surface of superior maxillary and malar bones; *insertion*, with its fellow upon the upper lip. Rel.—externally, to levator labii superioris alaque nasi; internally to transversalis nasi and orbicularis oris. Act.—to raise the upper lip.

Depressor labii inferioris. Sit.—beneath the lower lip. Fig.—triangular. Att.—*origin*, superior border of lower

jaw ; *insertion*, skin of lower lip. REL.—externally, to panniculus ; internally, to alveolo-labialis. ACT. — to depress the lower lip.

Levator menti. SIT. — antero-inferior part of chin. FIG. — quadrilateral. ATT.—*origin*, external surface of lower jaw beneath the incisor teeth ; *insertion*, into the substance of lower lip. REL. — externally, to skin and depressor labii inferioris ; internally, to mucous membrane. ACT.—to depress the lower lip.

Transversalis nasi, a single muscle. SIT. — superior surface of alæ nasi, directed transversely. ATT.—to the two cartilages of the nose. REL.—externally, to nasalis longus labii superioris ; internally, to cartilages of the nose. ACT.—to dilate the nostrils.

Nasalis brevis labii superioris. SIT.—the angle between the nasal and maxillary bone. FIG.—triangular. ATT.—*origin*, anterior and superior maxillary bones ; *insertion*, skin of false nostril and transversalis nasi. REL —externally, to nasalis longus labii superioris and levator labii superioris ; internally, to mucous membrane of nose. ACT. —to dilate the external nares and false nostrils.

Depressor alæ nasi. SIT.—in front of anterior maxillary bone. FIG.—triangular. ATT.—*origin*, anterior maxillary bone a little above the alveolar margin ; *insertion*, inferior turbinated bone. REL.—externally, to nasalis brevis labii superioris and tendon of nasalis longus labii superioris ; internally, to the pituitary membrane of the nose. ACT. —to dilate the anterior nares.

Lachrymo-labialis. SIT.—beneath the orbit. FIG.—triangular. ATT.—*origin*, lower border of orbit and inner canthus ; *insertion*, subcutaneous fascia of cheek. REL.—externally, to skin ; internally, to nasalis longus superioris. ACT.—to corrugate the skin below the eye.

Mento-labialis, a single muscle. SIT.—inferior aspect of chin. FIG.—short flattened mass. ATT.—*origin*, sym-

physis of lower jaw; *insertion*, skin of lower lip and orbicularis oris. REL.—externally, to skin and depressor labii inferioris; internally, to orbicularis oris and mucous membrane of lips. ACT.—to depress the lower lip.

TEMPORO-MAXILLARY REGION.

(SIX MUSCLES.)

Masseter (*plate* 2, *no.* 4). SIT.—lateral part of face. FIG. — irregularly quadrilateral. ATT. — *origin*, lower surface of zygoma; *insertion*, outer aspect of ramus of lower jaw. REL.—externally, to panniculus and skin; internally, to alveolo-labialis and depressor labii inferioris; anteriorly, to facial artery, vein, and Stenonian duct; posteriorly, to parotid gland. ACT.—to raise the lower jaw.

Temporalis (*plate* 3, *no.* 1). SIT.—temporal fossa. FIG.—triangular. ATT.—*origin*, temporal fossa and crest surrounding it; *insertion*, coronoid process, and anterior border of lower jaw. REL. — externally, to temporo-auricular muscles, scutiform cartilage of ear, and adipose tissue of the orbit; internally, to pterygoideus internus and externus. ACT.—to elevate the lower jaw and pull it backwards.

Pterygoideus internus. SIT. — intermaxillary space. FIG.—irregularly quadrilateral. ATT.—*origin*, pterygoid process of sphenoid; *insertion*, upon the roughened cavity on inner surface of lower jaw. REL.—externally, to pterygoideus externus and temporalis; internally, to tensors palati, hyo-glossus longus, digastricus, guttural pouch, larynx, pharnyx, and submaxillary gland. ACT.—to raise the lower jaw and turn it to one side.

Pterygoideus externus. SIT.—anterior surface of temporo-maxillary joint. FIG.—short and conical. ATT.—*origin*, inferior part of sphenoid bone and its pterygoid

process; *insertion*, neck of lower jaw. REL.—externally, to temporalis, and capsular ligament of the temporo-maxillary joint; internally, to pterygoideus internus, and branch of fifth pair of cranial nerves. ACT.—to raise the lower jaw and assist in turning it to one side.

Stylo-maxillaris. SIT.—between occiput and posterior border of lower jaw. FIG.—triangular. ATT.—*origin*, styloid process of occiput; *insertion*, posterior border of lower jaw near its angle. REL.—externally, to parotid gland and sterno-maxillaries; internally, to guttural pouch, digastricus, and hyoideus magnus. ACT.—to depress the lower jaw.

Digastricus. SIT.—inner aspect of lower jaw. FIG.—biventral. ATT.—*origin*, styloid process of occiput, and passes through an aperture in the hyoideus magnus; *insertion*, inferior surface of lower jaw about the centre. REL.—externally, to stylo-maxillaris, pterygoideus internus and externus; internally, to hyoideus magnus, larynx, and sub-maxillary gland. ACT.—to depress the lower jaw.

HYOIDEAN REGION.

(SIX MUSCLES.)

Hyo-thyroideus. SIT.—between hyoid bone and larynx. FIG.—quadrilateral. ATT.—*origin*, semi-circular portion of os hyoides; *insertion*, postero-inferior part of thyroid cartilage. REL.—externally to sterno-hyoideus, sterno-thyro-hyoideus, subscapulo-hyoideus; internally to thyroid cartilage, and thyro-hyoid ligament. ACT.—to elevate the ligament.

Mylo-hyoideus. SIT.—between the rami of the lower jaw. FIG.—semipenniform. ATT.—*origin*, alveolar processes of lower jaw; *insertion*, lower aspect of hyoid bone, and in the median line with a fibrous raphe and its fellow. REL.—inferiorly to digastricus; superiorly to

buccal membrane, sublingual gland, genio-hyoideus, genio-glossus, and muscles of the tongue; internally, with its fellow. ACT.—to support the tongue and draw it forwards.

Genio-hyoideus. SIT.—superior aspect of last-named muscle. FIG.—fusiform. ATT.—*origin*, inferior border of lower jaw near its symphysis; *insertion*, appendix of hyoid bone. REL.—externally, to mylo-hyoideus; internally, to its fellow; superiorly, to genio-glossus. ACT.—to draw hyoid bone forwards.

Hyoideus magnus. SIT.—behind the long horn of hyoid bone. FIG.—fusiform and slender. ATT.—*origin*, angle of large hyoidean cornu; *insertion*, tubercle of spur process of same bone. REL.—externally, to pterygoideus internus; internally, to pharynx; inferiorly, to digastricus; superiorly, to glosso-pharyngeal nerve. ACT.—to elevate and retract the os hyoides.

Hyoideus parvus. SIT.—above the preceding muscles. FIG.—triangular. ATT.—*origin*, posterior border of small horn; *insertion*, arm of spur process of hyoid bone. REL.—externally, to hyo-glossus brevis; internally, to mucous membrane of pharynx. ACT.—to approach the cornu to the body of os hyoides.

Stylo-hyodius. SIT.—between occiput and hyoid bones. FIG.—triangular. ATT.—*origin*, styloid process of occiput; *insertion*, large cornu of os hyoides. REL.—externally, to parotid gland; internally, to guttural pouch. ACT.—to pull the os hyoides backwards and downwards.

LARYNGEAL REGION.

(ELEVEN MUSCLES.)

Crico-thyroideus. SIT.—postero-lateral part of larynx. FIG.—triangular. ATT.—borders and side of cricoid and posterior border of thyroid cartilage. ACT.—to approximate the two cartilages.

Crico-arytenoideus posticus. SIT.—upper aspect of larynx. FIG. — triangular. ATT. — superior aspect of cricoid and posterior angle of arytenoid cartilage. ACT.—to draw the arytenoid backwards.

Crico-arytenoideus lateralis. SIT.—supero-lateral aspect of larynx. FIG. — oblong. ATT. — anterior border of cricoid, and the lateral aspect of arytenoid cartilage. ACT.—To draw the arytenoid cartilages asunder, and thus dilate the glottis.

Thyro-arytenoideus. SIT.—between thyroid and arytenoid cartilages. FIG. — quadrangular. ATT. — inner aspect of thyroid cartilage and crico-thyroid ligament, also side of arytenoid cartilage ACT. —the same as the foregoing muscle.

Arytenoideus. SIT.—upper aspect of arytenoid cartilage. FIG.—square. ATT.—superior surface of arytenoid cartilages. ACT. — to contract the glottis by approximating the two cartilages.

Hyo-epiglottideus. SIT. — between hyoid bone and epiglottis. FIG.—fusiform, a single muscle. ATT.—neck of os hyoides and base of epiglottis. ACT.—to elevate the epiglottis and thereby dilate the opening of the larynx.

LINGUAL REGION.

(FIVE PAIRS OF MUSCLES.)

Hyo-glossis longus. SIT.—external aspect of tongue near its tip. FIG.—narrow band. ATT.—*origin*, external surface of long horn of hyoid bone ; *insertion*, substance of tongue, its fibres terminating at its tip. REL.—externally, to mylo-hyoideus, sublingual gland, and buccal membrane ; *internally*, to hyo-glossus brevis, and genio-glossus. ACT.—to pull the tongue backwards and to one side.

Hyo-glossus brevis. SIT.—inner aspect of hyo-glossus

longus. FIG. — quadrilateral. ATT. — *origin*, external surface of body and spur process of os hyoides ; *insertion*, lateral aspect of tongue, its fibres interlacing with the other muscles of the tongue. Rel.—externally, to hyo-glossus longus and mylo-hyoideus ; internally, to genio-glossus, hyoideus parvus, pharyngo-glossus and small horn of os hyoides. ACT.—to pull the tongue backwards and to one side.

Genio-glossus. SIT.—inferior aspect of tongue. FIG.—quadrilateral. ATT.—*origin*, branch of lower jaw near the symphysis ; *insertion*, inferior surface of tongue. REL.—externally, to genio-hyoideus, sublingual gland, and mucous membrane ; internally, to its fellow. ACT.—to pull the tongue forwards, backwards, and downwards.

Lingualis. SIT.—root of tongue. FIG. — prismatic. ATT.—*origin*, superior surface of body and spur process of os hyoides ; *insertion*, superior aspect of tongue, where its fibres interlace with the lingual muscles. REL.—externally, to hyo-glossus muscles ; internally, to its fellow. ACT.—to pull the tongue backwards.

Pharyngo-glossus. SIT.—lateral part of pharynx. FIG. —quadrangular. ATT. — *origin*, external surface of pharynx ; *insertion*, base of the tongue. REL.—externally, to genio-glossus ; internally, to muscles of pharynx. ACT. —to draw the pharynx forward.

PHARYNGEAL REGION.

(THREE PAIRS OF MUSCLES.)

Constrictor pharyngeus anterior. SIT.—superior aspect of pharynx. FIG.—triangular. ATT.—*origin*, pterygoid process of sphenoid ; *insertion*, mucous membrane of pharynx. REL.—externally, to pterygoideus internus and externus ; internally, to mucous membrane of pharynx. ACT.—a constrictor of the pharynx.

Constrictor pharyngeus medius. SIT. — behind the former muscle. FIG.—a flattened band. ATT.—*origin*, antero-internal surface of spur process of hyoid bone; *insertion*, mucous membrane of pharynx. REL.—externally, to digastricus, hyoideus magnus; internally, to superior constrictor of pharynx. ACT.—to constrict the pharynx.

Constrictor pharyngeus posterior. SIT.—infero-lateral surface of pharynx. FIG.—quadrilateral, and consists of two parts. ATT.—*origin*, cricoid and thyroid cartilages of larynx; *insertion*, supero-lateral aspect of pharynx. REL.—to the pharyngeal muscles. ACT.—a constrictor of pharynx.

Hyo-pharyngeus. SIT.—supero-lateral surface of pharynx. FIG.—a thin band. ATT.—*origin*, internal surface of large horn of hyoid bone; *insertion*, supero-lateral part of pharynx. REL.—externally, to hyoideus magnus; internally, to the constrictors of pharynx. ACT.—to dilate the pharynx.

Palato-pharyngeus. SIT.—posterior part of soft palate. FIG.—irregular. ATT.—*origin*, posterior border of palatine bone; *insertion*, posterior border of soft palate and antero-superior part of pharynx. REL.—covered on both sides with mucous membrance, muscles of pharynx, and soft palate. ACT.—to pull the soft palate upwards and backwards.

Stylo-pharyngeus. SIT.—postero-lateral part of pharynx. FIG.—slender band. ATT.—*origin*, styloid process of temporal bone and outer aspect of the Eustachian tube; *insertion*, lateral part of pharynx. REL.—pterygoid muscles and mucous membrane of pharynx. ACT.—to dilate the pharynx.

There is occasionally found a slight band of muscular fibres passing from the posterior border of arytenoid cartilage of larynx to inferior aspect of pharynx, and to

the upper extremity of œsophagus: this is termed the *aryteno-pharyngeus*. It tends to contract the pharyngeal cavity in a longitudinal direction.

PALATAL REGION.

(TWO PAIRS OF MUSCLES).

Circumflex palati. SIT.—superior surface of soft palate. FIG.—cylindrical. ATT.—*origin*, fibrous portion of palate and border of palatine bones; *insertion*, border of soft palate. REL. — posteriorly, to palato-pharyngeus and buccal membrane. ACT.—to raise the soft palate and dilate the fauces.

Tensor palati. SIT.—supra-lateral surface of pharynx. FIG.—fusiform. ATT.—*origin*, styloid process of temporal bone; *insertion*, posterior border of soft palate; its tendon is peculiar by playing over a pulley situated upon the inner surface of pterygoid bone. REL.—externally, to the pterygoidei muscles and mucous membrane. ACT.—to render tense the velum palati.

PALPEBRAL REGION.

(THREE MUSCLES.)

Orbicularis palpebrarum (*plate* 2, *no.* 5). SIT.—around the eyelids. FIG —oval, perforated in the centre. ATT.—at the inner canthus of the eye to a tubercle upon lachrymal bone, and to the fibrous covering of the eyelids. REL.—externally to skin, and in upper eyelid to levator palpebrarum superioris externus; internally, to fibrous tissue of eyelids. ACT.—to close the eyelids.

Levator palpebrarum superioris externus. SIT.—superior aspect of orbit. FIG.—rhomboid. ATT.—*origin*, superior part of frontal bone; *insertion*, skin and orbicularis palpebrarum of upper lid. REL.—externally, to skin; internally, to frontal bone. ACT.—to corrugate the skin and elevate the upper eyelid.

Levator palpebrarum superioris internus. SIT.—between the eyeball and orbital roof. FIG.—fan shaped. ATT.—*origin*, upper and internal aspect of optic foramen; *insertion*, posterior surface of tarsal cartilage. REL.—superiorly, to lachrymal gland; inferiorly, to superior rectus of eyeball. ACT.—to elevate the upper eyelid.

ORBITAL REGION.

(SEVEN MUSCLES.)

Retractor oculi. SIT. — surrounds the optic nerve. FIG.—a hollow cone. ATT.—*origin*, margin of optic foramen; *insertion*, posterior third of sclerotic seat of eye. REL. — externally, surrounded by the recti muscle; internally, to optic nerve. ACT.—to draw the eyeball backwards.

Recti, four in number—a *superior*, *inferior*, *internal*, and *external*. SIT.—around the eyeball. FIG.—individually, they are triangular. ATT.—*origin*, around the margin of optic foramen; *insertion*, external surface by sclerotic coat. REL. — externally, to fibrous sheath of orbit; internally, to sclerotic coat and adipose tissue. ACT.—when acting singly, the eyeball is turned in that direction; when one pair act, the eyeball has an oblique direction.

Superior oblique. SIT.—supero-internal part of orbit. FIG. — elongated and cylindrical. ATT. —*origin*, from superior border of optic foramen; *insertion*, to sclerotic, between the superior and external recti muscles. REL.—superiorly to the pathetic nerve; inferiorly, to internal rectus and sclerotic coat. ACT.—to rotate the eyeball upwards. This muscle bends upon itself at the internal aspect of the orbit, where it plays through a pulley which is connected to the orbital process of the frontal bone.

Inferior Oblique. SIT. — inferior aspect of eyeball. FIG.—cylindroid. ATT.—*origin*, lachrymal fossa; *insertion*,

sclerotic coat between the external and inferior recti muscles. Rel.—inferiorly, to floor of orbit; superiorly, to sclerotic coat; internally, to lachrymal sac. Act.—to rotate the eyeball downwards and outwards.

MUSCLES OF ANTERIOR EXTREMITY.

EXTERNAL SCAPULAR REGION.

(four muscles.)

Abductor Brachii. Sit. — postero-external aspect of shoulder. Fig.—irregularly quadrilateral. Att.—*origin*, posterior angle and superior part of spinous process of scapula; *insertion*, deltoid ridge and external tuberosity of humerus. Rel. –externally, to panniculus; internally, to teres externus and triceps brachii. Act.—to flex the shoulder.

Teres externus. Sit.—postero-external border of scapula. Fig.—elongated and trilateral. Att.—*origin*, posterior border of scapula; *insertion*, external tubercle of humerus. Rel.—externally, to abductor brachii; internally, to triceps extensor brachii, and capsular ligament of shoulder joint. Act.—to flex the humerus.

Antea spinatus (*plate* 2, *no.* 24). Sit.—antea spinata fossa of the scapula. Fig.—triangular. Att.—*origin*, antea spinata fossa and anterior border of spine of scapula; *insertion*, inner and outer tubercles of humerus. Rel.—externally to cervical trapezius; internally, to scapula; posteriorly, to postea spinatus; anteriorly, to pectoralis parvus. Act.—to extend the humerus.

Postea spinatus (*plate* 2, *no.* 25). Sit.—postea spinata fossa. Fig. — triangular. Att.—*origin*, postea spinata fossa, spine, and posterior border of scapula; *insertion*, external tubercle and deltoid ridge of humerus. Rel.—externally, to abductor brachii and panniculus; internally,

to triceps extensor brachii; anteriorly, to antea spinatus muscle. ACT.—to abduct the humerus.

INTERNAL SCAPULAR REGION.

(THREE MUSCLES.)

Subscapularis. SIT.—subscapular fossa. FIG.—triangular. ATT.—*origin*, subscapular fossa; *insertion*, internal tubercle of humerus. REL.—externally, to scapula; internally, to serratus magnus; anteriorly, to antea spinatus; posteriorly, to teres internus. ACT.—to adduct the humerus.

Teres Internus. SIT.—postero-internal border of scapula. FIG.—trilateral. ATT.—*origin*, posterior angle of scapula and fascia of subscapularis; *insertion*, internal tuberosity of humerus. REL.—externally, to scapulo-ulnaris, caput medium; internally, to serratus magnus; anteriorly, to subscapularis. ACT.—to adduct and flex the humerus upon the scapula.

Scapulo-humeralis gracilis. SIT.—postero-internal aspect of shoulder joint. FIG.—fusiform. ATT.—*origin*, margin of glenoid cavity, and external surface of capsular ligament of shoulder joint; *insertion*, head of humerus. REL.—covered by the muscles of the shoulder joint. ACT.—to draw out the capsular ligament and thus prevent it being pinched during the movement of the joint.

ANTERIOR HUMERAL REGION.

(THREE MUSCLES).

Coraco-humeralis (*plate* 3, *no.* 21). SIT.—internal aspect of arm. FIG.—pyramidal. ATT.—*origin*, coracoid process of scapula; *insertion*, inner surface of humerus, above and beneath the internal tuberosity of the same bone. REL.—externally, to humeralis externus, caput

medium, and subscapularis ; internally, to pectoral muscles. ACT.—to adduct and assist in the flexion of humerus.

Coraco radialis, or flexor brachii (*plate* 2, *no.* 34, *and plate* 3, *no.* 22). SIT.—anterior part of arm. FIG.—cylindrical. ATT.—*origin*, coracoid process of scapula ; *insertion*, bicipital tuberosity of radius and extensor metacarpi magnus muscle. REL.—externally, to levator humeri and sterno-aponeuroticus ; internally, to pectoralis parvus and coraco-humeralis. ACT.—to flex the fore-arm.

Humeralis externus. SIT. — musculo-spiral groove of humerus. FIG.—oblong and twisted. ATT.—*origin*, supra-posterior aspect of humerus ; *insertion*, supero-internal part of radius. REL. — externally, to caput medium ; internally, to tendon of teres internus, and latissimus dorsi ; anteriorly, coraco-radials. ACT.—to flex the fore-arm.

POSTERIOR HUMERAL REGION.

(THREE MUSCLES.)

Scapulo-ulnaris. SIT.—postero-internal surface of the triceps extensor brachii. FIG.—oblong and flat. ATT.—*origin*, posterior border of scapula ; *insertion*, posterior border of olecranon. REL.—externally, to triceps extensor brachii ; internally, to teres internus and pectoralis magnus. ACT.—to extend the fore-arm.

Triceps extensor brachii (*plate* 2, *nos.* 30 *and* 31) is composed of three heads—the *caput magnum*, *medium*, and *parvum*.

Caput magnum. SIT.—angle between scapula and humerus. FIG. — triangular. ATT. — *origin*, posterior border of scapula ; *insertion*, summit of olecranon. REL.—externally, to panniculus, abductor brachii, and teres externus ; internally, to scapulo-ulnaris, latissimus dorsi, and teres internus. ACT.—to extend the fore-arm.

Caput medium. SIT.—postero-external part of fore-arm.

Fig.—quadrilateral. Att.—*origin*, curved line below head of humerus; *insertion*, summit of olecranon. Rel.—externally, to abductor brachii and teres externus; internally, to caput parvum, humeralis externus, and extensor metacarpi magnus. Act.—to extend the fore-arm.

Caput parvum. Sit.—infero-internal aspect of the arm. Fig.—quadrilateral. Att.—*origin*, internal surface of humerus; *insertion*, summit of olecranon and brachial fascia. Rel.—externally, to caput medium and humeralis externus; internally, to coraco-humeralis, tendons of the teres internus, and latissimus dorsi. Act.—to extend the fore-arm.

Anconeus. Sit.—olecranon fossa. Fig.—triangular. Att.—*origin*, margin of olecranon fossa; *insertion*, anterior border of olecranon. Rel.—posteriorly, covered by the triceps extensor brachii; anteriorly, to elbow joint. Act.—to extend the fore-arm and to guard the capsular ligament.

ANTERIOR BRACHIAL REGION.

(FOUR MUSCLES.)

Extensor metacarpi magnus (*plate* 2, *no.* 33). Sit.—anterior surface of fore-arm. Fig.—pyramidal and elongated. Att.—*origin*, epitrochlean crest and anterior surface of humerus; *insertion*, supero-internal aspect of large metacarpal bone. Rel.—externally, to extensor pedis; internally, to humeralis externus; anteriorly, to coraco-radialis, humeralis externus, and extensor metacarpi obliquus. Act.—to extend the metacarpus.

Extensor metacarpi obliquus (*plate* 3, *no.* 25). Sit.—antero-inferior part of radius. Fig.—triangular. Att.—*origin*, antero-external aspect of radius; *insertion*, head of internal small metacarpal bone. Rel.—anteriorly, to extensor pedis and brachial fascia; posteriorly, to radius,

extensor metacarpi magnus, and capsular ligament of knee joint. ACT.—to extend the metacarpus.

Extensor pedis (*plate* 2, *no.* 35, *and plate* 3, *no.* 23). SIT.—external aspect of fore-arm. FIG.—pyramidal and elongated. ATT.—*origin*, epitrochlean crest, lower extremity of humerus, and external lateral ligament of elbow joint; *insertion*, pyramidal process of os pedis. REL.—externally, to brachial fascia and extensor suffraginis; internally, to extensor metacarpi magnus and obliquus. ACT.—to extend the phalanges.

Extensor suffraginis (*plate* 2, *no.* 37). SIT.—postero-external part of radius. FIG.—elongated. ATT.—*origin*, external lateral ligament of elbow joint, external tuberosity of radius, and outer surface of ulna; *insertion*, supero-internal aspect of os suffraginis. REL.—externally, to brachial fascia; internally, to fore-arm; anteriorly, to extensor pedis; posteriorly, to flexor metacarpi externus. ACT.—to extend the fetlock joint.

POSTERO-BRACHIAL REGION.

(SEVEN MUSCLES.)

Flexor metacarpi externus (*plate* 2, *no.* 36). SIT.—postero-external part of fore-arm. FIG.—elongated and flattened. ATT.—*origin*, the external condyle of the humerus; *insertion*, trapezium bone and head of external small metacarpal bone. REL.—externally, to extensor suffraginis; internally, to flexor medius; posteriorly, to brachial fascia. ACT.—to flex the metacarpus.

Flexor metacarpi medius. SIT.—posterior part of fore-arm. FIG.—elongated and flattened. ATT.—*origin*, inner condyle of humerus; *insertion*, trapezium bone. REL.—anteriorly, to flexor pedis perforatus; posteriorly, to brachial fascia and ulnaris accessorius; externally, to flexor metacarpi externus; internally, to flexor metacarpi internus. ACT.—to flex the metacarpus.

Flexor metacarpi internus. SIT. — postero-internal surface of fore-arm. FIG. - elongated and flattened. ATT.—*origin*, the condyle of the humerus; *insertion*, head of internal small metacarpal bone. REL.—externally, to flexor metacarpi medius; internally and posteriorly, to brachial fascia; anteriorly, to flexor pedis perforatus. ACT.—to flex the metacarpus.

Flexor pedis perforatus *(plate 3, no. 26)*. SIT.—behind the radius. FIG.—elongated and cylindrical. ATT.—*origin*, epicondyle of humerus; *insertion*, by a double tendon upon the lateral aspects of os coronæ. REL.—covered by the flexors metacarpi; anteriorly, by flexor pedis perforans. ACT. - to flex the phalanges.

The tendon of this muscle receives the insertion of a strong fibrous band near the lower extremity of the radius (*radial ligament*), and, a little above the fetlock joint, it forms a ring, through which passes the tendon of *flexor pedis perforans.*

Flexor pedis perforans *(plate 3, no. 28)*. SIT.—posterior aspect of radius. FIG.—elongated and cylindrical. ATT.—*origin*, epicondyle of humerus; *insertion*, semi-lunar crest of os pedis. REL.—posteriorly, to flexor pedis perforatus; anteriorly, to radialis accessorius and radius. ACT.—to flex the phalanges.

The tendon of this muscle receives the tendons of the *ulnaris* and *radialis accessorius*. In the middle third of the metacarpus it receives the *metacarpal ligament;* at the posterior part of the sesamoid bones it plays through a ring formed by the tendon of the *flexor pedis perforatus.*

Flexor ulnaris accessorius. SIT. — behind the arm. FIG.—triangular and elongated. ATT.—*origin*, posterior border of olecranon; *insertion*, tendon of flexor pedis perforans. ACT.—similar to flexor pedis perforans.

Radialis accessorius. SIT.—postero-inferior part of radius. FIG.—elongated. ATT.—*origin*, upper third of

radius; *insertion*, tendon of perforans above the knee joint. ACT.—same as flexor pedis perforans.

MUSCLES OF THE FOOT.

(TWO PAIRS OF MUSCLES.)

Lumbrici, two in number. These delicate bundles of muscular fibres originate from the *perforans tendon*, and become inserted upon the sheath of the *sesamoid* bones.

Interossii metacarpi consist of two small bundles of fibres situated upon the inner surface of splint bones; they arise from these bones, and are inserted upon the tendon of the extensor pedis. The interossii muscles are not always present, but when they are they usually arise by two small fleshy bodies in the groove formed by the large and small metacarpal bones; when forming two small tendons, they diverge around the posterior ends of these bones and are lost in the attachments of the flexor muscles of the foot.

As the tendons belonging to the foot play over the bones and articulations of that region, they are kept in their position by sheaths of fibrous tissue; and where they pass over the knee, they are surrounded by a strong band, *annular ligament*, which is derived from the fascia of the fore-arm. At the fetlock joint there is another sheath of the same construction, *sesamoid ligament*. The tendon of the perforans is connected posteriorly to a strong band of fibrous tissue, *posterior digital ligament*, which arises from the lateral aspect of the *os suffraginis*, and becomes inserted upon the semi-lunar crest of *os pedis*.

MUSCLES OF HIND EXTREMITY.

HAUNCH.

(EIGHT MUSCLES.)

Gluteus externus (*plate* 2, *no.* 55). SIT.—external sur-

face of haunch. Fig.—triangular. Att.—*origin*, external angle of ilium and sacrum, sacro-sciatic ligament, and outer border of ischium; *insertion*, trochanter minor externus. Rel.—externally, to abductor femoris and fascia; internally, to gluteus medius; anteriorly, to tensor vaginæ femoris. Act.—to abduct and extend the femur.

Gluteus medius or **maximus** (*plate* 3, *no.* 30, *and plate* 2, *no.* 56). Sit.—dorsum surface of ilium. Fig.—irregular rhomboid. Att.—*origin*, fascia of longissimus dorsi, external and internal angles of ilium, also sacro-sciatic ligament; *insertion*, trochanter minor externus, and posterior aspect of femur between the two small trochanters. Rel.—externally, to gluteus externus; internally, to longissimus dorsi, iliac fossa, gluteus internus, sacro-iliac and sacro-sciatic ligaments. Act.—to extend and abduct the femur, and assist in the act of rearing.

Gluteus internus. Sit.—postero-external aspect of the neck of ilium. Fig.—quadrilateral. Att.—*origin*, neck of ilium and supra cotyloid crest; *insertion*, anterior aspect of trochanter major. Rel.—externally, to gluteus medius; internally, capsular ligament of hip joint. Act.—to abduct the femur and rotate it inwards.

Pyriformis. Sit.—within the pelvis. Fig.—penniform. Att.—*origin*, internal aspect of ilium, antero-external angle of sacrum; *insertion*, trochanterian fossa. Rel.—externally, to ilium, internally, to peritoneum and rectum; outside the pelvis it is related to the gluteus medius. Act.—to rotate the femur outwards.

Obturator internus. Sit.—inside the pelvis. Fig.—triangular. Att.—*origin*, external margin of obturator foramen; *insertion*, trochanterian fossa. Rel.—superiorly, to bladder and peritoneum; inferiorly, to pubis and ischium. Act.—to rotate the femur forwards.

Obturator externus. Sit.—inferior surface of pelvis. Fig.—triangular. Att.—*origin*, external margin of obtu-

rator foramen; *insertion*, trochanterian fossa. REL.—inferiorly, to adductor femoris, pectineus and quadratus femoris; superiorly, to capsular ligament of hip joint and obturator internus. ACT.—to adduct the femur.

Gemini. SIT.—external surface of ischium. FIG.—quadrilateral. ATT.—*origin*, external border of ischium; *insertion*, tendons of pyriformis and obturator internus. REL.—anteriorly, to obturator externus and capsular ligament of hip joint; supero-posteriorly, to obturator internus and pyriformis. ACT.—to rotate the femur outwards.

Ischio-femoralis. SIT. — supero-posterior surface of femur. FIG.—a flattened band. ATT.—*origin*, inferior aspect of ischium; *insertion*, posterior part of femur at its upper third. REL.—postero-internally, to adductor magnus; anteriorly, to obturator externus; externally, to gemini. ACT.—to extend the femur and assist in adduction.

ANTERIOR FEMORAL REGION.

(THREE MUSCLES.)

Tensor vaginæ femoris. SIT.—antero-external part of thigh. FIG.—triangular. ATT.—*origin*, external angle of the ilium; *insertion*, upon fascia lata of the thigh. REL.—externally, to skin; internally, to iliacus and triceps extensor cruris; posteriorly, to panniculus and gluteus externus. ACT.—To render tense the fascia lata and flex the femur upon the pelvis.

The **triceps extensor cruris** consists of three muscles—the *rectus femoris*, *vastus internus*, and *externus*.

Rectus femoris (*plate* 2, *no.* 62, *and plate* 3, *no.* 34). SIT.—front of the thigh. FIG.—fusiform. ATT.—*origin*, fossa upon the ilium in front of the acetabulum; *insertion*, anterior part of patella. REL.—externally, to vastus externus; internally, to vastus internus; posteriorly, to ilio-femoralis and capsular ligament of the hip joint;

anteriorly, to fascia. ACT.—to extend the limb and flex the femur upon the pelvis.

Vastus internus *(plate 3, no. 35)*. SIT.—antero-internal part of thigh. FIG.—semi-ovoid. ATT.—origin, antero-internal aspect of neck of femur; *insertion*, tendon of rectus femoris and supero-internal part of patella. REL.—externally, to rectus femoris; internally, to adductor magnus, pectineus, iliacus, and sartorius. ACT.—to extend the leg.

Vastus externus *(plate 2, no. 63)*. SIT.—antero-external part of thigh. FIG.—semi-ovoid. ATT.—*origin*, antero-external part of femur; *insertion*, supero-external surface of patella. REL.—externally, to tensor vaginæ and gluteus externus; internally, to rectus femoris; posteriorly, to femur and abductor femoris. ACT.—to extend the leg.

Ilio-femoralis. SIT.—anterior part of hip joint. FIG.—fusiform. ATT.—*origin*, external part of neck of ilium; *insertion*, anterior surface of femur at its upper fourth. REL.—posteriorly, to the capsular ligament of hip joint and triceps extensor cruris. ACT.—to guard the capsular ligament, and assist in the flexions of the femur.

INTERNAL FEMORAL REGION.

(FIVE MUSCLES.)

Sartorius. SIT.—internal aspect of the haunch bone. FIG.—elongated and prismatic. ACT.—*origin*, tendon of psoas parvus; *insertion*, internal lateral ligament of patella. REL.—internally, to psoas magnus, iliacus, anterior femoral nerve, and covered by the fascia lata. ACT.—to adduct the leg and flex the femur.

Gracilis. SIT.—inner aspect of thigh. FIG.—quadrilateral. ATT.—*origin*, ischio-pubic symphysis; *insertion*, internal lateral ligament of patella. REL.—externally, to the fascia lata; internally, to pectineus, adductors femoris, and semi-tendinosis. ACT.—to adduct the limb.

Pectineus. SIT.—antero-internal part of thigh. FIG.—fusiform. ATT.—*origin*, inferior part of pubis and prepubian tendon; *insertion*, a ridge below the trochanter minor internus. REL.—externally, to gracilis and sartorius; internally, to iliacus, psoas magnus, and vastus internus; posteriorly, to adductors femoris. ACT.—it flexes and adducts the femur.

Adductor parvus. SIT.—inner aspect of thigh. FIG.—triangular. ATT.—*origin*, symphysis pubis, and inferior surface of ischium; *insertion*, posterior surface of femur, below the small trochanters. REL.—externally, to gracilis; internally, to the obturator internus and pectineus; posteriorly, to adductor magnus. ACT.—to adduct and extend the femur.

Adductor Magnus. SIT.—behind the former muscle. FIG.—elongated and prismatic. ATT.—*origin*, symphysis pubis and inferior surface of ischium; *insertion*, posterior surface and internal condyle of femur, also internal lateral ligament of stifle joint. REL.—externally, to gracilis; posteriorly, to semi-membranosis; anteriorly, to ischio-femoralis and obturator externus. ACT.—to extend, adduct, and rotate the femur.

POSTERIOR FEMORAL REGION.

(THREE MUSCLES.)

Semi-membranosis (*plate* 3, *no.* 37). SIT.—postero-internal part of thigh. FIG.—elongated and prismatic. ATT.—*origin*, ischiatic tuberosity, spine of sacrum, and first three tail bones; *insertion*, internal condyle of femur. REL.—externally, to gracilis; internally, to triceps abductor; anteriorly, to adductor magnus; posteriorly, to semi-tendinosis. ACT.—to adduct and extend the femur, and assist in the act of rearing.

Semi-tendinosis (*plate* 2, *no.* 61). SIT.—posterior sur-

face of thigh. FIG.—prismatic and bifid superiorly. ATT. —*origin*, spines of sacrum, sacro-sciatic ligament, spine of ischium, and first three tail bones; *insertion*, anterior tibial crest. REL.—externally, to triceps abductor, and gluteal fascia; internally, to semi-membranosis. ACT.—to flex the thigh and render tense the fascia of the leg.

Triceps abductor femoris. SIT.—external surface of thigh. FIG.—prismatic and trifid. ATT.—*origin*, sacral spines, sacro-sciatic ligament, tuberosity and spine of ischium; *insertion*, posterior surface of femur, external surface of patella, crest of tibia, and fascia of leg. REL. —externally, to gluteal fascia; internally, to adductor magnus, semi-membranosis, and semi-tendinosis. ACT.— to abduct and extend the thigh, also render tense the fascia lata (*plate* 2, *no.* 54).

ANTERIOR TIBIAL REGION.

(THREE MUSCLES.)

Extensor pedis (*plate* 3, *no.* 41). SIT.—antero-external surface of leg. FIG.—fusiform. ATT.—*origin*, fossa between external condyle and trochlea of femur; *insertion*, pyramidal process of os pedis. REL.—anteriorly, to tibial fascia and part of triceps abductor femoris; posteriorly, to flexor metatarsi. ACT.—to extend the phalanges on the metatarsus.

Peroneus. SIT.—antero external part of leg. FIG.— cordiform. ATT.—*origin*, external lateral ligament of stifle joint, and external part of fibula; *insertion*, tendon of extensor pedis a little above the fetlock joint. REL.— externally, to tibial fascia; posteriorly, to flexor pedis perforans; anteriorly, to extensor pedis. ACT.—same as former muscle.

Flexor metatarsi. SIT.—outer surface of tibia. FIG.— fusiform, and bifurcated inferiorly. ATT.—*origin*, fossa

PLATE 3.—DEEP LAYER OF MUSCLES.

1. Temporalis.
2. Rectus capitis anticus major.
3. Sterno-thyro-hyoideus.
4. Sterno-maxillaris.
5. Trachea.
6. Scalenus.
7. Splenius.
8. Upper border of the cervical ligament.
9. Proper elevator of the shoulder.
10. Longus colli.
11. Cartilage of the scapula.
12. Rhomboideus muscle.
13. Levatores costarum.
14. Semi-spinalis dorsi et lumborum.
15. Serratus magnus.
16. Internal intercostals.
18. Rectus abdominis.
19. Deep pectoral.
20. Postea spinatus.
21. Coraco humeralis.
22. Coraco radialis.
23. Extensor pedis.
24. Extensor metacarpi magnus.
25. Extensor metacarpi obliquus.
26. Flexor pedis perforatus.
28. Flexor pedis perforans.
29. Internal oblique.
30. Gluteus maximus.
31. Supra-coccygeals.
32. Lateral-coccygeals.
33. Inferior coccygeals.
34. Rectus femoris.
35. Vastus internus.
36. (The semitendinosus and long vastus are removed).
37. Semimembranosus.
38. Gastrocnemii.
39. Flexor pedis perforatus
40. Flexor pedis perforans.
41. Extensor pedis.
42. Flexor metatarsus.

between trochlea and external surface of tibia; *insertion*, antero-superior part of large metatarsal bone, cuneiform medium, and outer surface of cuboid bone. REL.—anteriorly, to extensor pedis; posteriorly, to tibia. ACT.—to flex the metatarsus.

This muscle is peculiar in being formed of two parts—a tendinous and a muscular portion; the former corresponds to the peroneus tertius of man; in the horse it serves simply the purpose of a ligament.

POSTERIOR TIBIAL REGION.

(SIX MUSCLES.)

Gastrocnemius (*plate* 2, *no.* 65; *and plate* 3, *no.* 38). SIT.—posterior surface of tibia FIG.—bicipital. ATT.—*origin*, outer border of supra-condyloid fossa and crest of same name; *insertion*, summit of os calcis. REL.—posteriorly, to triceps abductor femoris, semi-tendinosis, and semi-membranosis; anteriorly, to perforatus, popliteus, and flexor pedis accessorius. ACT. — to extend the metatarsus.

Solens. SIT.—postero-external part of leg. FIG.—a thin narrow band. ATT.—*origin*, posterior part of the head of tibia; *insertion*, summit of os calcis. REL.—externally, to the skin; postero-internally, to gastrocnemius. ACT.—to extend the metatarsus.

Flexor pedis perforatus (*plate* 3, *no.* 39). SIT.—between the gastrocnemius and tibia. FIG.—cordiform. ATT.—*origin*, supra-condyloid fossa of femur; *insertion*, by a double tendon upon supra-lateral aspect of os coronæ. REL.—anteriorly, to flexor pedis perforans; posteriorly, to gastrocnemius. ACT.—to flex the phalanges upon the metatarsus.

The tendon of this muscle forms a cartilaginous cap which glides over the summit of the os calcis.

Flexor pedis perforans (*plate* 3, *no.* 40). SIT.—posterior aspect of leg and metatarsus. FIG. — elongated and fusiform. ATT.—*origin*, external tuberosity of tibia, and outer surface of same bone; *insertion*, semi-lunar ridge of pedal bone. REL.—externally, to solens; internally, to popliteus and flexor pedis accessorius; posteriorly, to gastrocnemius and perforatus. ACT.—to flex the phalanges upon the metatarsus.

The tendon of this muscle receives a strong fibrous band below the hock joint, *metatarsal ligament*; beneath this point the tendon of this muscle and perforatus comport themselves as their homologues upon the anterior extremities.

Flexor pedis accessorius. SIT.—posterior part of tibia. FIG.—fusiform. ATT.—*origin*, posterior part of external tuberosity of tibia; *insertion*, upon tendon of flexor pedis perforans near the upper third of metatarsal bone. REL.—anteriorly, to popliteus; posteriorly, to gastrocnemius and perforatus. ACT.—similar to perforans.

Popliteus. SIT. — posterior surface of stifle joint. FIG. — triangular. ATT. — *origin*, external condyle of femur; *insertion*, roughened surface upon posterior part of tibia. REL.—externally, to flexor pedis accessorius and perforans; internally, to semi-tendinosis and fascia; posteriorly, to gastrocnemius and perforatus; anteriorly, to capsular ligament of stifle joint and posterior surface of tibia. ACT.—to flex the tibia upon the femur and rotate it inwards.

MUSCLES OF THE FOOT.

The muscles of the foot correspond to those previously described existing in the fore extremities, with the exception of a small muscle situated upon the external surface of the large metatarsal bone. This *muscular slip* arises from

the lower extremity of the *os calcis*, and is inserted upon the tendon of the *peroneus* and *extensor pedis* muscle, between which tendons it is always situated.

The tendons of the muscles of the foot, as they pass over the bones and articulations of that region, are arranged in the same manner as those of the anterior extremities.

CIRCULATORY APPARATUS.

The **circulatory apparatus** effectuates the circulation of the blood, and consists of a *heart*, *arteries*, *capillaries*, and *veins*. The *heart*, which is the central organ of the system, is located within the thorax, where it is isolated from the surrounding parts by a sac called the *pericardium*.

PERICARDIUM.

The **pericardium** is a conical sac placed obliquely between the lungs, having its base presented upwards and forwards, and its apex downwards and backwards. It is composed of two parts—an external fibrous coat and an internal serous membrane. The fibrous portion is attached superiorly, to the outer coats of the large blood vessels situated at the base of the heart; it is also attached to the sheath of the *longus colli muscle;* inferiorly, to the upper aspect of the *sternum*, the *sterno-triangularis muscle*, and slightly to the tendinous portion of the *diaphragm*. The *serous membrane* is formed of two layers—an *outer* or *parietal*, and an *inner* or *visceral*. The *parietal* lines the inner surface of the fibrous covering, while the *visceral* covers the external aspect of the heart. The space between these layers contains a small quantity of fluid, *liquor pericardii*, which preserves a freedom of motion between the heart and sac. In health this is about an ounce in quantity, but when it becomes much increased beyond this it constitutes dropsy of the pericardium.

HEART.

The **heart** is a conical muscular organ, having its base connected with the large blood vessels, and situated below

the bodies of the third, fourth, and fifth dorsal vertebræ, while its apex is free and looks downwards and backwards towards the upper aspect of the sternum. It is composed of two halves—a right, which is directed forwards, and a left, which looks backwards. These divisions have between them a septum, which is indicated externally by a groove. Each half consists of two portions—a superior or *auricle*, and an inferior or *ventricle*.

The **auricle** is formed of two parts, one of which is reticulated upon the inside by numerous ridges, *musculi pectinati*, and is called the appendix. The other portion, *sinus venosus*, is smooth, and presents the openings of the veins which communicate with its cavity. The *right auricle* presents the orifices of the anterior and posterior venæ cavæ, venæ azygos, coronary vein, foramina of Thebesii, and the auriculo-ventricular opening. Upon the septum auricularum there exists a small fossa, the vestige of the foramen ovale. At each of the orifices of the posterior vena cava and coronary vein is a fold of membrane called the *Eustachian* and *Thebesian* valves, and between the opening of the two venæ cavæ a slight muscular eminence —*tuberculum Loweri*.

The **left auricle** (*plate* 4, *no.* 3) contains the orifices of the four pulmonary veins, and the opening which leads into the left ventricle, and is similar in structure to that of the right auricle.

The **right ventricle** (*plate* 4, *no.* 1) is thicker in its coats than the auricles; its cavity is conical in form, and presents at its base the auriculo-ventricular opening with the tricuspid valve. In front of that opening is situated the infundibulum or orifice of the pulmonary artery with the semi-lunar valve. Upon its septum, which is convex, and its outer wall is found a number of eminences, *columnæ carnæ*. These columns are of three kinds, one of which gives origin to the moderator bands, which are

directed transversely from the septum to the outer wall; the second is conical, *musculi papillares*, and gives attachment to small fibrous cords, *chordæ tendinæ;* while the third variety forms only small elevations on the walls of the ventricle. The *tricuspid valve* consists of three segments composed of the lining membrane, *endocardium*, of the ventricle, and strengthened by the insertion of the chordæ tendinæ which arise from the musculi papillares. The *semi-lunar* or *sigmoid valve* consists of three cusps also formed by the *endocardium* (lining membrane of the heart), each of which presents at its apex a small hard body or nodule, *corpus Arantii*, which meet at the centre, where the valve closes the opening of the pulmonary artery; and between the valves and the commencement of the pulmonary artery are three pouches or dilations, one behind each segment of the valve, which are called the ***sinuses of Valsalva.***

The **left ventricle** *(plate 4, no. 2)* is similar in shape to the right one; its walls, however, are twice as thick, and form the apex of the heart. There are two openings into its cavity—the auriculo-ventricular and the aortic. Situated at the former there is the *bicuspid* or *mitral valve*, and at the latter the *semi-lunar valve*. These valves are similar in structure to those in the right ventricle, with this difference—that the one between the auricle and ventricle is composed only of two parts. The columnæ carnæ are fewer in number than in the right side, and the surface of the septum ventricularum is concave.

Structure.—The Heart is composed of muscular fibres and thick fibrous rings which serve for their attachment. The fibrous rings surround the auriculo-ventricular openings and the orifices of the aorta and pulmonary artery. Those of the left ventricle are stronger than those on the right side. The rings give attachment to the bases of the different valves. They also constitute the means

by which the aorta and pulmonary artery become connected to their respective ventricles. The muscular fibres have a very intricate arrangment, and are quite distinct in the auricles and ventricles. In the auricles they are arranged in a superficial and deep set, which have their fibres either looped or running in an annular direction. The fibres of the ventricles consist of nine layers, so disposed that the external fibres which run from above downwards increase so much in their obliquity that the middle layer is nearly transverse; the internal fibres are also arranged in an oblique direction, and thus decussate with the outer layers. The interior of the heart is lined by a smooth transparent serous membrane, *endocardium*, which is continuous with the internal coat of the great blood vessels.

PECULIARITIES OF THE CIRCULATORY APPARATUS OF THE FŒTUS.

The circulatory apparatus of the fœtus differs from that of the adult in having the two ventricles of the heart nearly the same in thickness; and the auricles communicating with each other by an opening in the septum, *foramen ovale*. The pulmonary artery also communicates with the posterior aorta by a large vessel, *ductus arteriosus*. From the internal iliac arteries arise two vessels, *umbilical arteries*, which run to the fœtal portion of the placenta, where they are distributed. The blood is returned from that organ by a large vein, *umbilical*, which divides and ramifies in the structure of the liver.

THE ACTIONS OF THE HEART.

The **physiology of the heart**, as the exciting cause of circulation, or the means by which it is enabled to act on its contents with regularity, has been a constant subject of physiological inquiry, and its actions will be best understood

by following the course of the blood. When the right auricle receives the blood from the anterior and posterior cavæ it suddenly contracts, and the veins being closed by their valves the blood rushes into the right ventricle, which, being stimulated to contract on it, shuts up the tricuspid valves which had permitted its entry. The contained blood, therefore, now seeks another course, and the same action that shut the ventricle opens the pulmonary artery by pressing the edges of its valves towards its sides, leaving its cavity extended, into which the blood by the contraction of the ventricle, is now forced. The blood thus received into the pulmonary artery proceeds to be circulated through the lungs, and when returned by the pulmonary veins to be emptied into the left auricle, which, having received it, becomes likewise stimulated to contract in its turn also, and the fluid then is forced into the left ventricle. Thus much of the motion of the blood is termed the *pulmonary circulation.*

The blood having entered the left ventricle, is prevented returning again into the left auricle by the closing of the mitral valves. The reciprocal contraction of the left ventricle drives the contained blood in the direction of its axis against the valves of the aorta, which dilating, allow the passage of the blood into this vessel, from whence it is distributed to every part of the body to furnish it with nutritious principles. The remainder being put into a retrograde course by means of the veins, is again poured from the trunks of the anterior and posterior cavæ into the right auricle, and thus the *general circulation* is completed.

It appears that the contraction of the two ventricles is synchronous (happening at the same time), and that at the same time that the blood is drawn from the left ventricle into the aorta, the right ventricle impels it into the pulmonary artery, and as the period at which the left

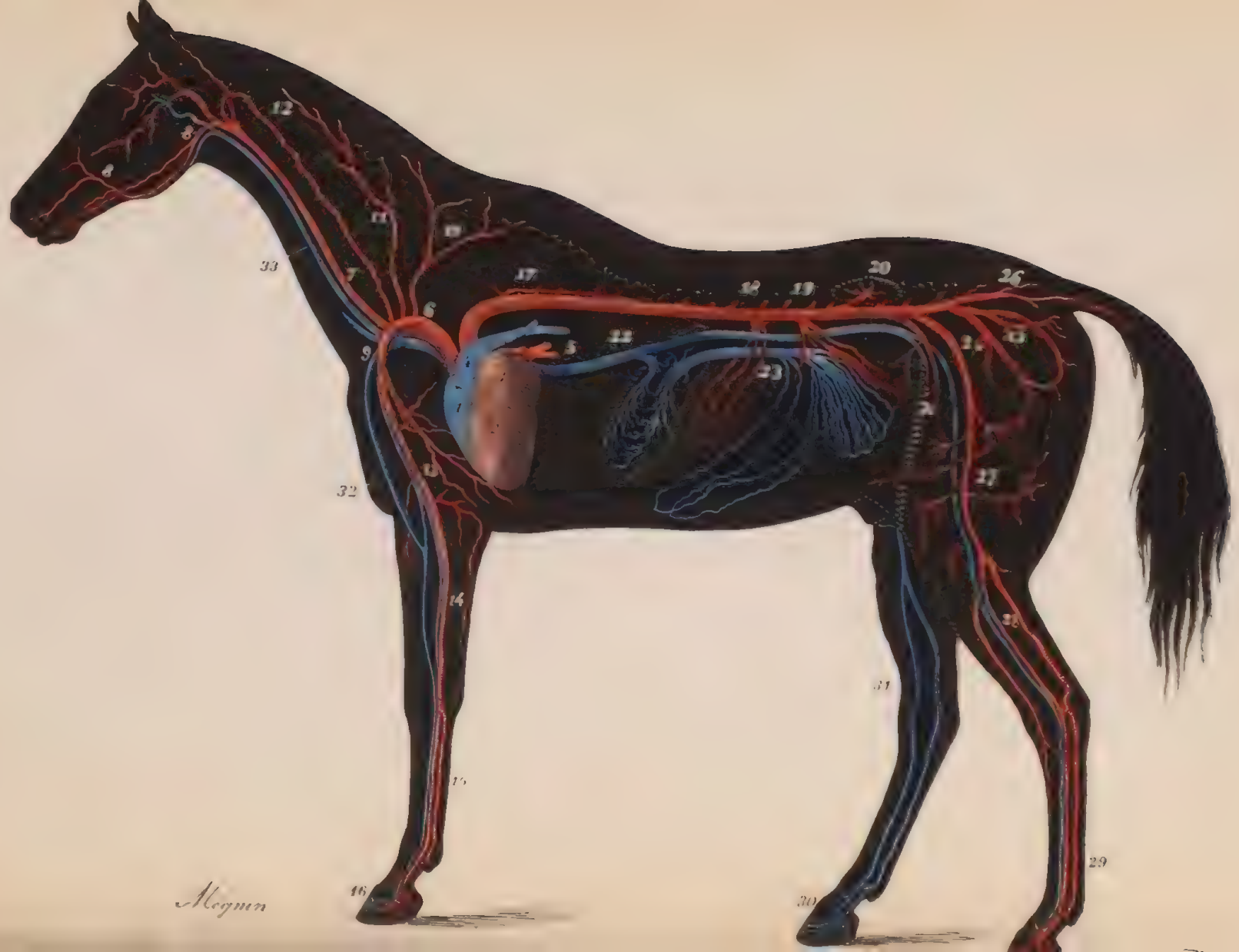
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PLATE 4.—CIRCULATORY APPARATUS.

(The left anterior limb has been removed to show the vessels on the inner aspect of the right limb.)

(With the exception of the two aortæ, the vena cava, and the vena portæ, all the other vessels are double and symmetrical: *i.e.* found on each side of the body.)

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1. Heart (right ventricle).
2. Heart (left ventricle).
3. Heart (left auricle).
4. Pulmonary artery.
5. Pulmonary veins.
6. Anterior aorta.
7. Carotid artery.
8. External maxillary artery.
9. Left axillary artery.
10. Dorsal axillary artery.
11. Superior cervical artery.
12. Vertebral artery.
13. Humeral artery.
14. Radial artery.
15. Metacarpal artery.
16. Coronary or digital artery.
17. Posterior aorta.
18. Cœliac trunk distributed to the stomach.
19. Mesenteric vessels.
20. Renal artery.
21. Spermatic artery.
22. Posterior vena cava.
23. Vena portæ.
24. External iliac artery.
25. Internal iliac artery.
26. Lateral sacral artery.
27. Femoral artery.
28. Posterior tibial artery.
29. Metatarsal artery.
30. Venous network of the foot.
31. Internal saphena vein.
32. Superficial brachial vein.
33. Jugular vein.

auricle receives the pulmonary blood is the same with that in which the right auricle receives the blood of the cavæ, so it will be evident that the relaxation of the ventricles and the distension of the auricles are synchronous also. These alternate contractions and dilatations of the heart are called its *systole* and *diastole*. The contraction, or systole, pressing the blood into the arteries, distends them; when, uniting to the force of the heart a contractile power of their own, the blood is propelled through the body. It follows, therefore, that when the heart is in a state of contraction or systole, the arteries are in a state of distention or diastole, and it is at this period we feel what is termed their pulsation. It will therefore appear that the pulmonary and general circulations form but one direct round of transmission of blood through the animal body.

THE BLOOD.

The nature and properties of this *important* and *vital fluid* demand our attentive consideration. In essential characters and properties it is the same in all animals, but its specific gravity has been variously estimated, it being subject to increase and decrease at different times. Disease and emaciation makes it lighter, while, in the contrary states it is found heavier. If water is estimated at 1·000, the specific gravity of blood may be reckoned at 1·050, from which it may, however, be increased to 1·120. *Venous blood* is heavier than *arterial*.

The *temperature* of the blood in the horse is about 100°; in the ox, 102°; and in the sheep, 103°. *Arterial blood* is usually one or two degrees warmer than *venous*. The quantity that an animal contains, in proportion to its bulk, has been variously stated. Very fat animals are found to have proportionably less than lean ones; and in those in a state of close confinement the quantity is found

to be smaller than in the wild. A medium sized horse has lost forty-four pounds without apparent injury, and most of them will lose one-fifteenth of their total weight before life becomes extinct. It may, therefore, be presumed that it forms about one-eighth or tenth of the whole.

The *physical* and *microscopical* characters are very interesting. Blood as it flows from a divided vessel, is an opaque red viscid fluid. It appears to be homogeneous, but the microscope shows that it consists of cells floating in a fluid termed the *plasma* or *liquor sanguinis*. These cells are of two kinds, red and white. The *red cells* are bi-concave circular discs, like so many coins, measuring on an average $\frac{1}{3300}$ in. in diameter, and $\frac{1}{3}$ of that or $\frac{1}{10,000}$ in. in thickness. They are very minute, and the walls of the cells are so tough and elastic that they may be seen to squeeze through capillaries smaller than themselves, and regain their shape when freed from pressure. The red cells are composed of a wall of *globulin* and the matter within is called *hæmatin*, which is stated by Muller to be composed of, in 100 parts—carbon, 65·84; hydrogen, 5·37; nitrogen, 10·4; oxygen, 11·75; iron, 6·64; which last element exists probably in the unoxidised state. The main function of the red cells is to act as carriers of oxygen to the tissues, which are thereby oxidised, and returned in the venous blood as carbonic acid, urea, water, and other effete products, meanwhile setting free caloric. A parasite named *distoma hæmalobium* exists in blood.

The *white cells* are less numerous than the red, but they are larger, being $\frac{1}{2500}$ in. in diameter, and are spheroidal, pearly, and rough on the surface. Their exact chemical composition is undetermined, as they cannot be separated from the fibrin; in fact some physiologists consider the white cells and fibrin as identical. Their use is not positively known, but they are supposed to nourish the albuminous tissues.

The *chemical properties* of the blood are important. Variously compounded, it is distinctly separable into two parts—the one solid and red, the other fluid and slightly tinged with yellow. The former is called the *crassamentum*, the latter the *serum*. The process which separates them is termed *coagulation*. The spontaneous coagulation of the blood, and its resolution into serum and coagulum, forms, as it were, a step towards its analysis, which is thus given by LECANU* :—

Water	780·145
Fibrin	2·100
Colouring matter	133·000
Albumen	65·090
Fat (crystalline)	2·430
Ditto (oily)	1·310
Extractive, soluble in water and alcohol ...	1·790
Albumen united to soda	1·265
Chlorides of sodium and potassium ...	
Carbonates, Phosphates, Sulphates of potassa and soda ...	8·370
Carbonate of lime and magnesia ...	
Phosphate of lime, magnesia, and iron	2·100
Peroxide of iron	
Loss	2·400
	1000·000

The blood is, therefore, described as a compounded fluid made up of these several parts, and considered as an aggregate, is a most essential component of the animal. It is ever changing its composition, containing materials in a state of formation, maturity and decay.

ARTERIAL SYSTEM.

The **arteries** form a system of vessels which originate from the heart and are distributed over the various regions of the body. Each artery gives off a number of branches which are individually smaller than itself, but having an

* See BRAND'S Chemistry.

aggregate diameter greater than that of the vessel from which they arise. The arteries in their distribution anastomose freely with each other, an arrangement which, in a remarkable degree, tends to maintain a regular supply of blood to the different organs. Arteries were so named from being supposed to carry air, as they are found empty after death. They are cylindrical tubes when full, and so elastic as to remain so when empty. They consist of three coats—an *external*, a *median*, and an *internal*.

The **external** coat is formed of white fibrous and areolar tissue; it is the toughest of the three, and forms a matrix for the ramification of the nerves and nutrient vessels (*vasa vasorum*) of the artery.

The **middle** coat consists of two elements—a muscular, which is most abundant in small arteries, and an elastic, existing chiefly in large vessels; these structures are arranged in a transverse direction and impart to the artery the properties of contractility and elasticity.

The **internal** coat is very thin, and is also composed of two layers—an inner or epithelial, and an outer or elastic. The former consists of a single layer of fusiform cells which contain nuclei, and the latter a colourless glistening membrane formed of delicate elastic fibres, presenting numerous apertures or reticulations, from which appearance it has been termed the *fenestrated membrane*. The various arteries throughout the body are invested by a sheath formed of connective tissue. This sheath is absent in the small arteries of the brain and spinal cord. The evident use of the arteries is to convey the blood from the heart to the different parts of the body, thus keeping up the vital principle in these parts by being the bearers of nutriment and heat. Arteries freely communicate with each other. We also know that they terminate by means of their capillary branches in veins. They likewise terminate by *excretory ducts* on *secreting surfaces*, or within bodies called

glands, by which the arterial contents become in themselves changed; and part of the blood having remained to enter into new combinations, the remainder is returned by venal branches. Arteries have also another common termination, by *exhalent openings* on *extended surfaces;* it is by this means the insensible perspiration passes off, and by the same means serous fluids are emitted throughout most membranous surfaces and cavities.

A more confined termination of arteries is that into *cells*, from which veins arise to take it up again, as in the *spleen*. Different parts are more or less plentifully supplied with arteries according to their nature. *Secreting organs* have usually large trunks—as the *kidneys*, *spleen*, *liver*, &c. They are likewise themselves furnished with arterial and venal branches for the nourishment of their tubes. The living power of the arteries must be great, for they are capable of extending themselves through coagutable lymph thrown out previously. They are also furnished with nerves and absorbents.

PULMONARY ARTERY.

The **pulmonary artery** (*plate* 4, *no.* 4) arises from the infundibulum of the right ventricle of the heart, from which it curves upwards and backwards above the left auricle, where it divides into two branches—one for each lung, in which they have a similar distribution to the bronchial tubes.

AORTA.

[Explanation of contractions:—Div.—Division. Bra.—Branches. Sec. Bra.—Secondary Branches]

The **common aorta** arises from the base of the left ventricle and proceeds upwards and forwards, bifurcating upon the right side of the pulmonary artery into the anterior and posterior aorta. It is about two inches in length, and presents near its base three pouches, *sinuses of Valsalva*. Bra.—*right* and *left cardiac* arteries.

The **right cardiac artery** arises from one of the sinuses of Valsalva, from which it curves round the right side of the heart, where it bifurcates; one branch passing downwards in the ventricular groove, the other proceeding to join the left artery in the furrow between the left auricle and ventricle.

The **left cardiac artery** arises also from one of the aortic sinuses, and divides into two branches, one of which proceeds downwards in the left ventricular furrow, and anastomoses near the apex of the heart with the artery of the other side; the other branch curves round to the left side where it joins the right cardiac artery.

The *cardiac vessels* form a complete circle in the auricular ventricular groove. Their branches supply the substance of the heart.

ANTERIOR AORTA.

The **anterior aorta** *(plate* 4, *no.* 6*)* is the smallest division of the main trunk. It is about one inch in length, and proceeds upwards and forwards, dividing upon the left side of the anterior vena cava into the *right* and *left axillary* arteries. Bra.—a few small twigs to the pericardium and mediastinum.

Div.—The **right axillary artery**, the larger of the two, proceeds forwards beneath the trachea to the entrance of the thorax, where it turns round the anterior border of the first rib, being then directed backwards to the inner aspect of the shoulder, where it terminates in the humeral artery.

The **left axillary artery** (*plate* 4, *no.* 9) diverges from the right one, and curves upwards upon the left side of the trachea, terminating in the same manner as the right axillary artery. Each axillary artery gives off the *dorsal*, *superior cervical*, *vertebral*, *internal* and *external thoracic*, *inferior cervical*, and *external* and *internal scapular*; and upon the right side the *cephalic* arteries.

The **dorsal artery** (*plate* 4, *no.* 10) is the first vessel given off from the brachial trunk. It passes through the second intercostal space, and becomes distributed to the muscles of the withers and superior region of the neck. It anastomoses with the superior cervical, vertebral, and occipito-muscular branches. BRA.—the **sub-costal artery** is given off before the dorsal leaves the thorax. It passes backwards below the heads of the ribs, giving off in its course the *second*, *third*, and *fourth*, and sometimes the *fifth intercostal* arteries.

The **superior cervical artery** (*plate* 4, *no.* 11) arises by a trunk common to it and the dorsal upon the right side, but by a separate root upon the left side. It passes through the first intercostal space, and becomes distributed to the muscles of the superior cervical region, where it anastomoses with the vertebral, occipito-muscular, and dorsal arteries. BRA.—the *first intercostal* artery and a small twig to the spinal cord.

The **vertebral artery** (*plate* 4, *no.* 12) arises near the posterior border of the first rib. It passes through the vertebral foramina of the neck, terminating upon the lateral parts of the axoido-atloid articulation by uniting with a branch of the occipital artery. BRA.—a few small twigs to the deep-seated muscles of the neck and spinal cord.

The **internal thoracic** arises nearly opposite the vertebral, and passes down upon the inner aspect of the first rib along the chondro-sternal articulations near to the ensiform cartilage, where it terminates in the *thoracic* and *anterior abdominal* arteries. BRA.—a few twigs to the pericardium, pleura, pectoral muscles, and intercostal spaces.

The **thoracic artery** passes along the cartilages of the false ribs, terminating at the thirteenth intercostal space by uniting with its artery. BRA.—a few small twigs to intercostal spaces, diaphragm, and transversalis abdominis muscle.

The **anterior abdominal artery** leaves the thorax and becomes distributed chiefly to the rectus abdominis muscle, where it anastomoses with the posterior abdominal.

The **external thoracic artery** arises near the internal thoracic, and becomes distributed to the pectoral muscles.

The **inferior cervical artery** arises frequently with the former artery, and divides into two branches—a superior and an inferior. The former is distributed to the sub-scapulo-hyoideus and levator humeri muscles, and lymphatic glands near the shoulder joint. The latter supplies the levator humeri and pectoral muscles.

The **external scapular artery** arises opposite the tendon of the subscapularis. BRA.—they supply the antea and postea spinata muscles and shoulder joint.

The **internal scapular artery** arises where the brachial terminates in the *humeral* artery, from which it proceeds upwards to the posterior angle of the scapula where it terminates. BRA. — they supply the latissimus dorsi, serratus magnus, triceps extensor brachii, humeralis externus, levator humeri, and panniculus muscles.

HUMERAL ARTERY.

The **humeral artery** (*plate* 4, *no.* 13) from its origin at the head of the humerus, is directed obliquely downwards upon the inner aspect of the bone terminating near its lower extremity in the *anterior* and *posterior radial* arteries. BRA.—the **pre-humeral artery,** which supplies the coraco-radialis, levator humeri and sub-scapulo-hyoideus muscles and shoulder joint The **external ulnar artery** supplies the triceps extensor brachii, humeralis externus, and extensor muscles of the foot. The **internal ulnar artery** supplies chiefly the flexor muscles of the foot and knee joint. The **coraco-radial artery** supplies the coraco-radialis muscle.

DIV.—The **anterior radial artery** passes downwards in

front of the radius to the knee joint, where it ends in numerous branches which anastomose with the branches of the external ulnar and posterior radial arteries. BRA.—to the elbow joint and extensor muscles of the foot.

The **posterior radial artery** (*plate* 4, *no.* 14) passes over the internal ligament of the elbow joint, and down between the radius and the metacarpi internus muscle to the knee, where it divides into the *large* and *small metacarpal* arteries. BRA.—to the elbow joint and flexor muscles of the foot and knee. The **interosseous artery** of the fore-arm passes through the radio-ulnar arch, and becomes distributed to the extensor muscles and knee joint.

DIV.—The **small metacarpal artery** descends upon the postero-internal aspect of the carpus to the head of the internal splint bone, when it crosses over between the metacarpal and suspensory ligaments to their outer margin, where it anastomoses with a branch from the large metacarpal artery. BRA.—**posterior interosseous artery** gives off twigs to the tendons of the flexor muscles, suspensory ligament, and anastomoses above the fetlock with the large metacarpal artery. The **anterior interosseous artery** supplies the knee joint, tendons of the extensor muscles, and anastomoses with the preceding vessels and large metacarpal artery.

The **large metacarpal artery** (*plate* 4, *no.* 15) passes through the carpal arch upon the inside of the flexor tendons, which it accompanies to a little above the fetlock, where it divides into the *digital* arteries. BRA.—to the knee joint, where it joins with the internal ulnar, and anterior and posterior radial arteries; it supplies the tendons of the flexor muscles, suspensory ligament, and fetlock joint.

DIV.—The **digital arteries** (*plate* 4, *no.* 16) descend over the fetlock joint towards the alæ of the os pedis where they divide into the *plantar* and *pre-plantar* arteries. BRA.

—to the fetlock joint, and the tissue from which the ergots are developed ; also, to the tendons and their sheaths. The **perpendicular artery** arises near the middle of the os suffraginis, and is distributed to the anterior part of the fetlock joint, to the structures in front and behind the first and second phalanges, and several branches which anastomose with the coronary circle. The **lateral artery** of the frog arises from the upper border of the lateral cartilages, and is distributed to the sensitive structures of the sole and frog. The *coronary circle* is formed by an anterior and posterior branch from each digital artery, which anastomose with each other to form an arch above the navicular bone posteriorly, and inner side of the lateral cartilages and between the os coronæ and tendon of the extensor pedis anteriorly. From this circle arise the branches which form the plexus of the coronary band which anastomoses with those of the sensitive laminæ, sole, and frog.

Div.—The **preplantar artery** passes through the preplantar foramen into the semi-lunar sinus of the os pedis, where it anastomoses with its fellow and the plantar arteries. Bra.—to the coronary circle, lateral cartilages, and sensitive laminæ of the foot.

Div.—The **plantar artery** enters the semi-lunar sinus by the plantar foramen, where, with its fellow and the preplantar arteries, an arterial circle is formed, *plantar circle*, from which proceed numerous small branches. The *ascending* vessels pass through the foramina of the os pedis and supply the sensitive laminæ, and anastomose with the small arteries of the coronary band. The *descending* branches pass through the os pedis and form a circle around the margin of the os pedis, *circumflex artery of the foot*, from which vessel arise numerous branches which supply the sensitive sole.

CAROTID ARTERY.

The **cephalic trunk** or **common carotid** (*plate* 4, *no.* 7), shortly after its origin from the right axillary artery, divides into the two carotid arteries.

Each **carotid artery** passes along the outer aspect of the trachea to a little behind the larynx, where it divides into the *external* and *internal carotid* and *occipital arteries.* BRA.—to the cervical muscles, trachea, and œsophagus. The **thyro-laryngeal artery** arises near its termination, and gives off a branch to the larynx and another to the thyroid body.

DIV.—The **external carotid artery** passes upwards and forwards to near the condyle of the lower jaw, where it divides into the *superficial, temporal,* and *internal maxillary arteries.* BRA.—the **external maxillary artery** passes down upon the inner surface of the internal pterygoideus muscle, turns round the border of the lower jaw, then proceeds upwards in front of the masseter muscle, terminating near the maxillary spine in two small vessels. In its course it gives off numerous branches to the surrounding parts, such as the sub-maxillary and lymphatic glands, muscles of the face, and its integuments. SEC. BRA.—The **pharyngeal artery** to the pharynx and soft palate. The **lingual artery** to the substance of the tongue. The **sub-lingual artery** to the sub-lingual gland and extrinsic muscles of the tongue. The **inferior labial artery** to the lower lip, inferior incisor teeth, and maxillo-labialis muscle. The **superior labial artery** to the upper lip, where it anastomoses with the palato-labial artery.

DIV.—The two small terminal branches are distributed to the muscles of the face.

The **external maxillary artery** (*plate* 4, *no.* 8) arises near the large horn of the hyoid bone, and divides into two branches which are distributed to the masseter and pterygoidei muscles. BRA.—to the parotid gland and surround-

ing parts. The **posterior auricular artery** arises above the preceding artery. It passes upwards and terminates at the summit of the conchal cartilage of the ear. Bra.—to the conchal cartilage and its coverings, a twig to the middle ear which enters by the stylo-mastoid foramen, also several to the parotid gland. The **superficial temporal artery** is one of the terminating branches of the external carotid artery. After a short course it divides into the *anterior auricular* and *sub-zygomatic* arteries.

Div.—The **anterior auricular artery** gives off branches to the parotid gland, temporalis, anterior muscles, and conchal cartilage of the ear.

The **sub-zygomatic artery** turns round the border of the lower jaw and supplies the masseter muscle, where it anastomoses with the maxillo-muscular artery.

The **internal maxillary artery** is the larger of the two terminal divisions of the carotid ; it passes inwards to the base of the cranium, through the pterygoid foramen of the sphenoid bone, after which it proceeds to the maxillary hiatus, where it terminates in the palato-labial artery. Bra.—The **inferior dental** enters the inferior maxillary foramen, and supplies the molar and incisor teeth, also a small twig to the lower lip. The **pterygoid** arteries are two or three in number, and supply the pterygoidei muscles. The **tympanic artery** gives branches to the guttural pouch and middle ear, which last enters by the styloid foramen. The **middle meningeal artery** enters the cranium by the foramen lacerum basis cranii and ramifies upon the dura mater. The **posterior temporal artery** arises close to the pterygoid foramen, gives twigs to the temporalis muscle, and anastomoses with the masseter arteries. The **anterior temporal artery** arises in the pterygoid foramen and supplies the temporalis muscle. The **opthalmic artery** is given off in the pterygoid foramen, from which it passes into the cranium by the internal orbital foramen, where it

terminates in the meningeal and nasal arteries. Bra.—to the muscles of the eyeball; **ciliary arteries** to the globe of the eye; **central artery** of the retina; **lachrymal artery** to the lachrymal gland; **supra orbital artery** to upper eyelid, forehead, and muscles of the ear; **cerebral arteries** to the anterior lobe of the cerebrum.

Div.—The **meningeal artery** ramifies upon the anterior portion of the dura mater, and its reflection the falx cerebri.

The **nasal artery** leaves the cranium by the cribriform plates of the ethmoid bone, and is distributed to the olfactory portion of the Schneiderian membrane.

The **buccal artery** arises near the maxillary hiatus and supplies the molar glands and alveolo-labialis muscle.

The **superior dental artery** supplies the upper molar teeth, the mucous membrane of the maxillary sinus, lower eyelid, lachrymal sac, caruncula lachrymalis, and the cheek. The **spheno-palatine artery** is given off before the main trunk enters the palatine canal; it enters the nose by the nasal foramen, and is distributed to its mucous membrane. The **palato-labial artery** is the terminal branch of the internal maxillary artery; it passes along the palatine canal and palatine groove, near to the superior incisor teeth, where it joins its fellow; the branch resulting from this union leaves the mouth by the superior dental foramen, and supplies the upper lip and alæ of the nose. Bra.—to the soft and hard palate, also to the roots of the upper incisor teeth.

INTERNAL CAROTID.

The **internal carotid artery** proceeds upwards to the foramen lacerum basis cranii by which it enters the cranial cavity. It forms, immediately after its entrance into the cranium, two curves, the convexity of the one looking forwards and the other backwards. Near the latter curve

the carotid receives a branch from the *basilar* artery, and a short distance in front of it the two arteries communicate with each other by a transverse branch. The internal carotid divides near the optic nerves into the *posterior*, *anterior*, and *middle cerebral* arteries. Div.—the **posterior cerebral arteries** proceed backwards behind the pituitary body where they anastomose with each other, forming an arch upon the cerebral peduncles which receive the basilar artery. Its branches supply the posterior lobe of the cerebrum. The **middle cerebral artery** is lodged in the fissure of the Sylvius, and supplies the substance of the cerebrum. The **anterior cerebral arteries** unite in front of the optic tracts to form a single trunk which winds round the anterior extremity of the corpus callosum, and then divides into two vessels which are distributed to the cerebrum. Before they anastomose each vessel receives the meningeal branch of the opthalmic artery. The above anastomosis of the internal carotid, anterior cerebral, posterior cerebral, and basilar arteries, is termed the **circle of Willis.**

The **occipital artery** ascends to the wing of the atlas, where it passes through the anterior foramen and divides into the *occipito-muscular* and *cerebro-spinal* arteries. Bra.—the **prevertebral artery** gives off branches to the axoido-atloid articulation, recti muscles and dura mater. The **mastoid artery** enters the parieto-temporal canal by the mastoid foramen, where it anastomoses with a branch from the opthalmic artery; it gives off numerous branches to the muscles of the neck and temporalis. The **retrograde artery** anastomoses with the vertebral upon the wing of the atlas, and supplies the oblique muscles of the head.

Div.—The **occipito-muscular artery** supplies the muscles of the occipital region, where it anastomoses with the superior cervical and dorsal arteries.

The **cerebro-spinal artery** enters the spinal canal by the internal foramen of the atlas; it divides into two branches, an *anterior* and *posterior*. The former joins its fellow in the median line to form the basilar artery. The latter also joins its fellow to form the median spinal artery. The **basilar artery** is situated upon the basilar process of the occiput, and terminates by uniting with the posterior cerebral arteries. BRA.—the **posterior cerebellar arteries** supply the medulla oblongata, pons Varolii, and cerebellum. The **anterior cerebellar arteries** are distributed to the cerebellum and posterior parts of cerebrum, where they anastomose with the ramifications of the posterior cerebral arteries. The **median spinal artery** is directed backwards in the inferior groove of the spinal cord to its termination, receiving in its course the spinal branches of the vertebral, intercostals, lumbar, and sacral arteries; it supplies the spinal cord and its meninges.

POSTERIOR AORTA.

The **posterior aorta** (*plate* 4, *no.* 17) is the larger of the two divisions of the aorta; it curves upwards towards the spine, which it reaches near the seventh dorsal vertebra; it then enters the abdomen by the hiatus aorticus, in which cavity it passes backwards upon the left side of the posterior vena cava near to the sacro-lumbar articulations, where it divides into the **external** and **internal iliac** arteries. The branches of the posterior aorta may be divided into two groups—**parietal** and **visceral.**

PARIETAL GROUP.

The **intercostal arteries** are seventeen in number, thirteen of which arise from the *thoracic aorta;* three, and at times four, from the *dorsal;* and the first from the *superior cervical artery*. Each artery near the superior part of the

intercostal space divides into two branches, one of which is distributed to the inter-costal muscles; it anastomoses with branches from the internal thoracic, anterior and posterior abdominal arteries, and the circumflex artery of the ilium. The other branch is directed upwards, and supplies the muscles of the back, and gives off a small twig which passes into the spinal canal by the inter-vertebral foramen.

The abdominal portion of the aorta gives off two or three *diaphragmatic arteries*, which are distributed to the structure of the diaphragm. The **lumbar arteries** are five in number; they arise in a line with the *inter-costals*, and like them divide into two branches, one of which is distributed to the muscles of the loins, and the other to the psoas muscles and walls of the abdomen.

The **middle sacral artery**, which is not constantly found, originates from the aorta between the internal iliac arteries, and ramifies upon the inferior aspect of sacrum.

VISCERAL GROUP.

The **visceral** branches from the thoracic portion of the aorta are—the **bronchial arteries**, which accompany the bronchial tubes into the interior of the lungs. The **œsophageal arteries** arise by a common trunk with the bronchial vessels from the arch of the aorta, and are distributed to the œsophagus, anastomosing with the gastric arteries.

The **visceral** branches of the abdominal aorta are the **cœlic axis** (*plate* 4, *no.* 18), which is a remarkably short vessel. It divides into the *gastric*, *hepatic*, and *splenic* arteries.

The **gastric artery** divides, near the cardiac extremity of the stomach, into two branches which are distributed to the anterior and posterior surfaces of that organ; it gives off one or two branches which pass into the thorax and

anastomose with the œsophageal arteries, and ramify upon the base of the right or left lung.

The **hepatic artery** from its origin proceeds to the porta media of the liver, which it enters and becomes distributed along with the vena portæ to the substance of the gland. Bra.—the **pancreatic arteries** supply the structure of the pancreas; the **pyloric artery** arises near the origin of the duodenum, and is distributed to the pyloris and lesser curvature of the stomach, anastomosing with the gastric and right gastro-epiploic arteries. The **right gastro-epiploic artery** passes round the greater curvature of the stomach, where it anastomoses with the left gastro-epiploic artery. It gives off a branch which passes along the duodenum, and anastomoses with the duodenal branch of the mesenteric artery.

The **splenic artery** is the largest of the three branches given off from the cœlic axis; it passes downwards and to the left side in order to reach the hilus of the spleen, in which it runs to the apex of that organ, where it is continued round the greater curvature of the stomach, forming the *left gastro-epiploic* artery. Bra.—to the pancreas, spleen, and walls of the stomach. The **left gastro-epiploic artery** (belonging to the omentum) curves round the convex border of the stomach, and anastomoses with the right gastro-epiploic. The anastomoses of the vessels of the stomach with the œsophageal and anterior mesenteric arteries, form a rich vascular arch, from which proceed numerous branches to the walls of that organ and the omenta.

The **anterior mesenteric artery** (*plate* 4, *no.* 19) arises a little behind the former, and after a short course divides into three portions—a left, right, and an anterior. The *left* portion comprises about twenty vessels, which descend between the layers of the mesentery near to the attached border of the small intestine, where each vessel divides

into two branches, which form with one another a continued series of arches from which arise the branches that are distributed to the coats of the intestine. The first vessel unites upon the duodenum with the duodenal branch of the hepatic artery ; the last with the ilio-cæcal artery. The *right* portion comprises four arteries —the *ilio-cæcal*, two *cæcal*, and *right colic arteries.* The **ilio-cœcal artery** ramifies upon the terminal extremity of the ilium, where it anastomoses with the anterior mesenteric. The **cœcal arteries,** a *superior* and an *inferior*, are distributed to the cœcum, upon which they unite at its apex. The **right colic artery** accompanies the colon to the sigmoid flexure, where it anastomoses with the left colic artery. The *anterior* portion consists of the *left colic* and the first artery of the single colon. The **left colic artery** passes along the colon to the sigmoid flexure, where it anastomoses with the right colic artery. The branch to the single colon anastomoses with the posterior mesenteric artery, and with it ramifies upon the walls of the intestine. The anterior mesenteric artery gives also numerous branches to the mesenteric glands, suprarenal capsules, mesentery, and pancreas.

The **posterior mesenteric artery** arises posteriorly to the anterior mesenteric. It descends between the folds of the meso-colon, whence it proceeds backwards to the rectum and terminates near the anus. This trunk gives off thirteen to fourteen branches: — the first eight are arranged similarly to those of the small intestine, while the others are distributed to the terminal portion of the colon and rectum.

The **renal arteries** are given off near the anterior mesenteric. Each artery enters the hilus of the kidney and becomes distributed to the substance of the gland. The right artery is longer than the left, and both are peculiar by their great size in relation to the size of the kidneys. Bra.—to the supra renal capsules.

The **spermatic arteries** (*plate* 4, *no.* 21) arises sometimes in front and at others behind the posterior mesenteric artery. Each enters the corresponding inguinal canal, and after a flexious course is distributed to the structure of the testicle.

The **ovaro-uterine** is peculiar to the female. It divides into two portions—one of which is distributed to the ovaries, and the other to the uterus.

The **artery** of the **cord** arises between the external and internal iliacs, frequently by a root common to both. It is distributed to the spermatic cord. In the female this vessel, *uterine*, is larger than in the male, and divides into two branches which supply the uterus and vagina.

INTERNAL ILIACS.

The **internal iliac arteries** (*plate* 4, *no.* 25) arise from the terminal bifurcation of the posterior aorta, each of which after a short course divides into the *obturator* and *ilio-femoral* arteries. BRA.—the **umbilical artery** is very large in the fœtus, but becomes obliterated in the adult, existing only as a fibrous cord upon the lateral aspect of the bladder. The **internal pudic** arises along with the umbilical, and runs backward to the bulb of the urethra, where it terminates. It gives branches to the bladder, prostrate gland, urethra and its muscles, also to Cowper's glands. In the female it is distributed to the bladder, vagina, and vulva. The **lateral sacral** (*plate* 4, *no.* 26) arises near the sacro-lumbar articulation, and is directed to the apex of the sacrum, where it terminates in the *ischiatic* and *lateral coccygeal arteries*, and gives off branches to the surrounding parts, and to the spinal canal which they enter by the inferior sacral foramina. The **ischiatic artery** supplies the ischio-tibial muscles, where it anastomoses with the profunda-femoris and obturator arteries. The **lateral coccygeal artery** is directed backwards upon the side of

the tail, and is distributed to the muscles of that region. The **ilio-muscular artery** arises near the sacro-iliac articulation, and is distributed to the muscles of the sub-lumbar region, gluteus maximus, and fascia lata. The **gluteal artery** arises opposite the preceding one; it leaves the pelvis by the sciatic notch and supplies the gluteal muscles.

Div. — The **obturator artery** is one of the terminal branches of the internal iliac; it leaves the pelvis by the obturator foramen, and is distributed to the muscles upon the postero-internal aspect of the thigh. It gives off the **cavernous artery,** which passes along the dorsum of the pelvis, and is distributed to the corpus cavernosum of the penis.

The **ilio-femoral artery** is also a terminal branch of the internal iliac, and is chiefly distributed to the triceps extensor tibialis muscle.

EXTERNAL ILIACS.

The **external iliacs** (*plate* 4, *no.* 24) are two in number; each arises from the termination of the posterior aorta; from its origin it curves outwards and downwards to the front of the os pubis, where it passes through the crural arch, after which it receives the name of the *femoral artery*. The external iliac sometimes gives off the artery of the cord. Bra.—the **circumflex iliac artery** divides into two branches which are distributed to the abdominal muscles, anastomosing with the lumbar, and posterior and anterior abdominal arteries.

FEMORAL ARTERY.

The **femoral artery** (*plate* 4, *no.* 27) from its origin proceeds obliquely downwards and backwards to the popliteal artery. Bra.—The **prepubian artery** arises where the external iliac terminates in the femoral artery. It divides

into two branches—**posterior abdominal artery,** which passes along the inner aspect of the spermatic cord and is distributed to the abdominal muscles, and the **external pudic artery,** which divides into two portions—one of which is distributed to the sheath and skin of the abdomen, the other constitutes the **dorsal artery** of the penis. In the female this last branch supplies the mammary gland. The **profunda femoris** arises with the prepubian artery, and is distributed to the muscles upon the inner and posterior part of the thigh. The **saphena artery** arises near the middle of the femoral trunk ; it divides into two portions, one of which passes downwards to the inner part of the hock joint, where it terminates by anastomosing with branches from the posterior and anterior tibial arteries. The femoral artery gives off numerous small twigs to the surrounding parts, also the nutrient artery of the femur.

The **popliteal artery,** which is situated in the popliteal space, divides after a short course into the *anterior* and *posterior tibial arteries.* It gives branches to the stifle joint and surrounding muscles ; one of its branches is termed the **femoro-popliteal,** which descends as far as the hock, where it anastomoses with a branch from the posterior tibial artery.

The **anterior tibial artery** passes through the tibial arch down in front of the tibia and hock joint, below which it becomes the *metatarsal artery.* It gives off numerous branches to the tibial muscles and hock joint, one of which, the **perforating artery,** enters between the scaphoid and cuboid bones.

The **metatarsal artery** *(plate* 4, *no.* 29) descends obliquely in a groove upon the antero-external aspect of the large metatarsal bone. It passes through a canal situated between the large and small external metatarsal bones to the posterior aspect of the same, where it divides in a similar manner to the *large metacarpal* artery of the fore

limb. It gives off numerous branches to the surrounding structures of the metatarsus.

The **posterior tibial artery** *(plate* 4, *no.* 28*)* descends behind the leg to the hock, where it divides into branches which descend one upon the inside and the other upon the outside of the tendon of the flexor pedis perforans. At the superior part of the metatarsus the arteries anastomose with the perforating artery of the anterior tibial to form an arch, from which arise the two interosseous arteries of the metatarsus, which anastomose with the branches of the metatarsal artery. The posterior tibial gives off numerous branches to the posterior muscles of the leg, hock joint, and one which anastomoses at the point of the hock with the saphena artery.

The **digital arteries** arise from the metatarsal artery and are similar in their distribution to those of the anterior extremity.

CAPILLARIES.

The **capillaries** are interposed between the two great divisions of the vascular system: arteries, and veins. They exist in all the vascular structures of the body except erectile tissue. They form rounded or elongated meshes between the terminal arteries and rootlets of the veins. *Structure.*—Their walls consist of a thin homogeneous membrane similar to a cell wall, in which are imbedded minute oval cells. They are elastic and slightly contractile.

It is stated that the capillaries were discovered in 1661 by MALPIGHI, and till then there was a gap in HARVEY'S theory of the circulation of the blood. Their name does not express their fineness, as they measure but from $\frac{1}{100}$ in. to $\frac{1}{4000}$ in.; the smaller are found in the retina and brain, the larger in liver and lungs. They preserve the same width through the whole length from artery to vein. Their distribution follows the anatomical arrangement of the

various tissues, and when those of the muscle, the skin, membrane of the stomach, villi, &c., are injected, they are easily distinguished, and form some of the most brilliant of microscopic objects.

VENOUS SYSTEM.

The **veins** collect the blood from the capillaries and gradually enlarge as they approach their termination in the auricles of the heart. They are divided into three sets —*superficial*, *deep*, and *sinuses*. The **superficial** are found beneath the skin; the **deep** generally accompany the arteries; the **sinuses** are only found in the interior of the cranium, and are formed between the layers of the dura mater. The veins are cylindrical in form when full; they anastomose freely with each other and contain numerous valves.

Structure.—The walls consist of three coats similar to those of the arteries but much thinner, the smaller vessels being transparent. The valves of veins are semi-lunar, and formed by a re-duplication of their inner and middle coats. The walls of veins upon the cardiac aspect of the valves are pouched, these pouches corresponding numerically to the segments of the valves, which vary from one to three in number. The valves are most numerous in the veins of extremities and where the vessels are embedded among voluntary muscles. The valves are absent in the cerebral, spinal, and pulmonary veins; bone; and the small veins of the foot. Veins are furnished with arterial blood for their support by the *vasa vasorum*, which is returned by minute *venæ venarum*. They have also nerves, and without doubt possess absorbents.

PULMONARY VEINS.

The **pulmonary veins** (*plate* 4, *no.* 5.) originate in the

interior of the lungs, where they unite to form from four to eight branches which emerge from the root of each lung. These branches coalesce afterwards into four vessels which open into the left auricle. The **coronary** veins accompany the corresponding arteries; they unite to form a short trunk, **coronary sinus**, which opens into the right auricle below the orifice of the posterior vena cava. They receive the veins which correspond to the broncho-œsophageal arteries.

ANTERIOR VENA CAVA.

The **anterior vena cava** is formed between the two first ribs by the union of the two *jugular* and *axillary* veins. It receives in its course to the heart the *internal thoracic*, *vertebral*, *superior cervical*, *dorsal*, and *azygos* veins. The **internal thoracic vein** corresponds in its course to the artery of the same name. The **vertebral** and **superior cervical veins** correspond in their course to their respective arteries. The **dorsal vein** corresponds to the artery in its distribution upon the right side, but upon the left it originates as far back as the eleventh intercostal space, receiving the veins of the intercostal spaces which it passes. The *vertebral*, *superior cervical*, and *dorsal* veins unite upon the left side to form a common trunk.

The **vena azygos** begins near the first lumbar vertebra by several branches which communicate with the *posterior vena cava*; it receives fourteen costal veins upon the right side and five or six upon the left. This vessel opens into the anterior vena cava near its termination, and sometimes into the right auricle of the heart.

The **jugular veins** (*plate* 4, *no.* 33) begin near the temporo-maxillary joint by the union of the *superficial temporal* and *internal maxillary* veins. Each vein receives the following collateral branches—*posterior auricular*, *occipital*, *external maxillary*, *glosso-facial* and *thyroid*.

The *varicose* or *alveolar* branch of the *external maxillary* vein is lodged beneath the masseter muscle, where it presents a large dilation or sinus. It communicates anteriorly with the *anterior maxillary* vein, and after having passed through the ocular case, where it receives the veins of the eye, it opens into the cavernous sinus of the dura mater. The jugular vein receives a few other unimportant branches in its course towards the thoracic cavity.

The **superficial temporal vein** is formed by the union of two branches corresponding to the anterior auricular and sub-zygomatic arteries.

The **internal maxillary vein** is formed by the *buccal*, *lingual*, *inferior dental*, *deep temporal*, and *pterygoid* veins.

The **pterygoid veins** arise from the pterygoidei muscles and sub-sphenoidal sinus of the dura mater.

SINUSES OF THE DURA MATER.

These are formed between the layers of the dura mater. The **median sinus** is located in the falx cerebri, beginning at the crista galli and terminating in the parieto-temporal canals. The **cavernous sinus** is situated in the cavernous groove of the sphenoid bone, one on each side of the pituitary gland; each sinus receives the *alveolar* vein anteriorly, and communicates with its fellow posteriorly before opening into the sub-sphenoidal sinus. The **occipito-atloid sinus** is situated upon the inner aspect of the foramen magnum and the wing of atlas; it communicates anteriorly with the sphenoidal, posteriorly with the spinal sinus. The **petrous sinus** is formed in the tentorium, one upon each side; it communicates with the cavernous sinus and parieto-temporal canal. The **lateral sinus** is very irregular in form, is situated in the dura mater, which lines the cerebellar fossæ; it opens into the sub-sphenoidal sinus.

These *sinuses* receive the contents of the veins arising from different parts of the encephalon, and communicate with the jugular veins through the media of the *sub-sphenoidal sinus* and *parieto-temporal canal*. The **sub-sphenoidal sinus** is situated upon the side of the sphenoid bone and basilar process of the occiput; it communicates with the pterygoid and occipital veins. The **parieto-temporal canal** is formed by the occipital, parietal, and temporal bones; internally, it receives the median sinus, externally it opens into the superficial temporal vein. The **spinal sinuses** consist of a large vessel upon each side of the superior common ligament of the vertebræ, which begins at the atlas and terminates at the first coccygeal bone. They communicate freely with each other, and anastomose with branches from the surrounding parts.

AXILLARY VEIN.

The **axillary vein** is formed upon the inner aspect of the shoulder by the veins of this region. It curves round the first rib, and unites with its fellow and jugular veins to form the **anterior vena cava.** The **internal scapular vein** is similar in its course to the artery of the same name. The **external thoracic vein** constitutes the spur vein, and receives numerous branches from the pectoral muscles.

The **humeral vein** is formed above the elbow by the union of the veins of the fore-arm. It receives the vessels corresponding to the minor branches of the humeral artery. Veins of fore-arm—the **anterior** and **posterior radial,** which correspond in their course to their respective arteries.

The **ulnar vein** accompanies the internal ulnar artery. Superficial branches—**median vein,** which arises from the internal metacarpal vein. It divides into two branches, one of which, the *cephalic*, joins the jugular; the other, *basilar*, unites with the deep vein to form the humeral

trunk. The **anterior vein** arises from the carpal region, and terminates superiorly with the median vein.

The **internal metacarpal vein** arises near the fetlock and terminates in the median vein at the knee.

The **external metacarpal vein** arises at the fetlock joint, and terminates at the pisiform bone in the radial and ulnar veins.

The **digital veins** (*plate* 4, *no.* 30) arise upon the inner side of the lateral cartilages of the foot and terminate above the fetlock in the metacarpal veins.

The veins of the foot are divided into two groups—an *external* and an *internal*. The **external** group consists of the *solar*, *laminar*, and *coronary plexus*, which communicate with the *central* and *circumflex* veins. The **central vein** surrounds the sensitive frog, and the **circumflex** accompanies the artery of the same name; both terminate in a plexus, from which originates the digital veins. The **internal** group of veins correspond to the inter-osseous distribution of the plantar and preplantar arteries.

POSTERIOR VENA CAVA.

The **posterior vena cava** (*plate* 4, *no.* 22) is formed near the last lumbar vertebra by the union of *common iliac* veins. It runs along the lumbar region inclining to the right side of the spine; when about to leave the loins it receives the contents of the *spermatic* veins, and immediately after the *lumbar* veins, by one trunk, pour their contents into the larger vessel as well as the renal, and shortly afterwards it passes through the top of the liver. As it passes through this gland the vena cava is pierced by numerous openings upon its lower surface, which permits the return of the blood from the *hepatic* veins.

Having quitted the liver the vena cava passes through the right foramen of the diaphragm, and while going through this, receives the blood from the venous sinuses of

the diaphragm. The posterior then runs forward within its own investure of pleura to the right auricle, where it is joined by the *anterior cava*.

VENA PORTÆ.

The **vena portæ** (*plate* 4, *no.* 23) arises near the anterior mesenteric artery by the union of the *anterior* and *posterior mesenteric* with the **splenic** veins. It receives in its course towards the liver the right *gastro-epiploic* and *anterior gastric veins*. It enters the liver a little above the *hepatic* duct. Within its substance it divides and subdivides, and terminates in capillaries, from which originate the *hepatic* veins that empty their blood into the *posterior vena cava*. The vena portæ is said to be peculiar as originating by capillaries, running by branches to one common trunk, and then dividing to terminate in capillaries at both extremities. Besides this it has another peculiarity: it carries blood to the liver for secretion. All other veins carry away blood only after the secretion has been extracted from it.

COMMON ILIAC VEINS.

The **common iliac veins** are formed by the union of the *external* and *internal iliac* veins. The **internal iliac** is formed by branches which correspond to the vessels given off from the internal iliac arteries. The **external iliac** is formed at the anterior border of the pubis by the *femoral* vein. It receives the circumflex vein of the ilium before terminating in the *posterior vena cava*.

The **femoral vein** arises from the popliteal vein, and receives the satellite veins of the branches given off from the femoral artery.

The **popliteal vein** is formed by the union of the *anterior* and *posterior tibial* veins and the one corresponding to the femoro-popliteal artery. The deep vessels correspond in their course to the anterior and posterior tibial arteries.

Superficial vessels—the **internal saphena vein** (*plate* 4, *no.* 31) arises by two roots from the *internal* and *external metatarsal veins*, and terminates at the upper region of the thigh in the *femoral* vein. The **external saphena vein** arises at the os calcis, where it communicates with the *internal saphena* and those corresponding to the posterior tibial arteries, and terminates in the *popliteal* vein.

The **internal metatarsal vein** arises at the fetlock from the digital vein and terminates at the tarsus by two branches, one of which forms the *anterior tibial* vein and the other the *internal saphena* vein.

The **external metatarsal vein** arises at the fetlock and terminates at the hock in the *internal saphena* vein.

The **deep metatarsal vein** is situated between the suspensory ligament and the large metatarsal bone. It communicates below the hock with the interosseous veins, and passes between the cuboid and scaphoid bones to terminate in the *anterior tibial* vein.

The veins of the foot correspond to those of the anterior extremity.

LYMPHATIC SYSTEM.

The **lymphatics** consist of vessels and glands. The vessels are divided into two groups, viz. :—*lymphatics* and *lacteals ;* the latter are exclusively confined to the small intestine. The **lymphatic vessels** are found in all parts of the body except the brain, spinal cord, eyeball, cartilage, tendons, horn, and hair ; their existence in bone is doubtful. These vessels have delicate transparent walls, and present numerous constrictions in their course ; they have three coats—an *external areolar tissue, middle muscular and elastic tissue*, and an *internal epithelial.* The lymphatics contain numerous valves which generally exist in pairs and open towards the heart ; they are formed by the middle

and internal coats of the vessels. The lymphatics begin by delicate plexuses in the areolar tissue of organs, and anastomose with each other and proceed towards the lymphatic glands located near the place of their origin. It is by the agency of the lymphatics and lacteals that the material for the renewal of the vital fluid is collected, as well as the worn out particles of the body carried into the venous circulation. The lymphatics are best demonstrable in the living animal in the inside of the thigh and arms.

The **lacteals** are distinguished by that name in consequence of the milky appearance of the fluid which they convey. They are the mesenteric absorbents, and between its layers they are supported; they take their origin chiefly from the small intestines, absorb the chyle which has been produced by digestion, and after passing through two or three absorbent glands, empty their contents into the *receptaculum chyli.*

The **lymphatic glands** are arranged in groups in different regions of the body. They are oval in form and of a pinkish colour, and vary in size from a pea to a walnut. Each is covered by a capsule which, by numerous prolongations, forms a reticular framework in the interior of the gland. As the lymphatic vessels enter the gland their external coat becomes continuous with its capsule; they then divide into numerous minute branches which, after a tortuous course, unite into two or more vessels which, in leaving the gland, become again enveloped in their outer coat. In the interior of the glands the vessels are surrounded by granular cells and a plexus of capillary blood-vessels. The absorbent glands of the lacteals are called *mesenteric*, and those of the latter receive the name of *lympathic* glands.

THORACIC DUCT.

This large absorbent vessel is situated on the right side

of the vertebræ within the abdomen and thorax; it originates in a dilatation or reservoir situated at the root of the anterior mesenteric artery, formed by the union of several large lymphatics called the *receptaculum chyli*, from which it passes through the hiatus aorticus just opposite the base of the heart, crosses over to the left side and opens, through the intervention of another dilatation, into the anterior vena cava; the opening into the veins being guarded by a valve to prevent the admission of blood. The office of the thoracic duct is to convey the fluid collected by the lymphatics and lacteals into the circulation.

THE PHYSIOLOGY OF THE LYMPHATIC SYSTEM.

The functional effects of this system are very important and extremely active in the constitution at large; for we are certain that the various organs of the body are continually changing, wholly or partially, their component parts, either for renovation or alteration, whilst it appears to be the office of the arteries to build up new parts and to repair the waste of others. The old ones are removed by the lymphatics, *absorption*. By this wonderful power the roots of the temporaneous teeth are thus absorbed that their crowns may more easily give way; it is thus the vascular cartilages are taken up by the absorbents to make room for a bony deposit when the animal approaches maturity. By these the fluids as well as the solids are continually changing, being taken up and carried back into the mass of blood, from whence they are afterwards redeposited by the work of the arteries. It is by the lymphatics that the dead parts are separated from the living in sloughing and ulceration, and by them coagulable lymph and extravasated blood are removed.

The functional office of the lymphatics is most important for the preservation of life under casualties. Long fasting is thus borne; their capability of displacing the

animal oil or marrow from the bones, and the fat from the body generally, is employed to make up the want. Hybernating animals live during their torpidity by a slow absorption of adipose matter. The absorbents appear to possess a power also of selection with regard to the matters they take up. The lacteals exclusively employ themselves in the absorption of chyle, and the lymphatics also receive some matters and reject others. Besides the *healthy* and *ordinate* action of these vessels they have an *unhealthy* and *inordinate* one, likewise a proof that absorption is not an act of capillary attraction; if it were, their absorbing capacities would ever remain the same; but, on the contrary, we find that sometimes they scarcely act at all, while at others they are empowered with even too much energy.

LYMPHATICS OF THE POSTERIOR EXTREMITY.

These originate at the foot and ascend in company with the deep and superficial veins of the limb to a number of glands situated in the inguinal region. From these glands several large vessels arise which anastomose with the large branches of the pelvis.

LYMPHATICS OF THE PELVIC VISCERA.

These vessels, after traversing the iliac glands, are collected into two or three large branches which open into the receptaculum chyli.

LYMPHATICS OF ABDOMINAL VISCERA.

These consist of the lacteals from the small intestine and the lymphatics from other organs in the abdomen. The *lacteals* arise from the villi and sub-mucous tissue of the small intestine; they pass upwards between the folds of the mesentery to the mesenteric glands, which they again leave and unite to form two or three large vessels

which terminate in the thoracic duct. The *lymphatics* of the large intestine, stomach, pancreas, spleen, omentum, and kidneys, also pass through a series of glands and afterwards form a few large branches which open into the thoracic duct.

LYMPHATICS OF THE ABDOMINAL PARIETES.

These vessels proceed to the inguinal, axillary, and sub-lumbar glands, where they anastomose with others which are proceeding to the thoracic duct.

LYMPHATICS OF THE THORACIC VISCERA.

These vessels, belonging to the lungs, pass through the bronchial glands and enter the thoracic duct. Those from the heart enter the cardiac glands, afterwards uniting with those from the lungs. Those from the thoracic portion of the œsophagus, trachea, and thymus gland, unite with some of the above branches which communicate with the thoracic duct.

LYMPHATICS OF THE PARIETES OF THE THORAX.

These vessels proceed to the axillary glands. Those originating from the interior of this cavity traverse the sternal and dorsal glands, and then open into the thoracic duct.

LYMPHATICS OF THE LEFT FORE EXTREMITY.

These vessels, like those of the posterior extremities, originate at the foot, and are directed upwards, accompanying the veins to the axillary glands and from them to the thoracic duct.

LYMPHATICS OF THE RIGHT FORE EXTREMITY.

These vessels have a similar course to those upon the

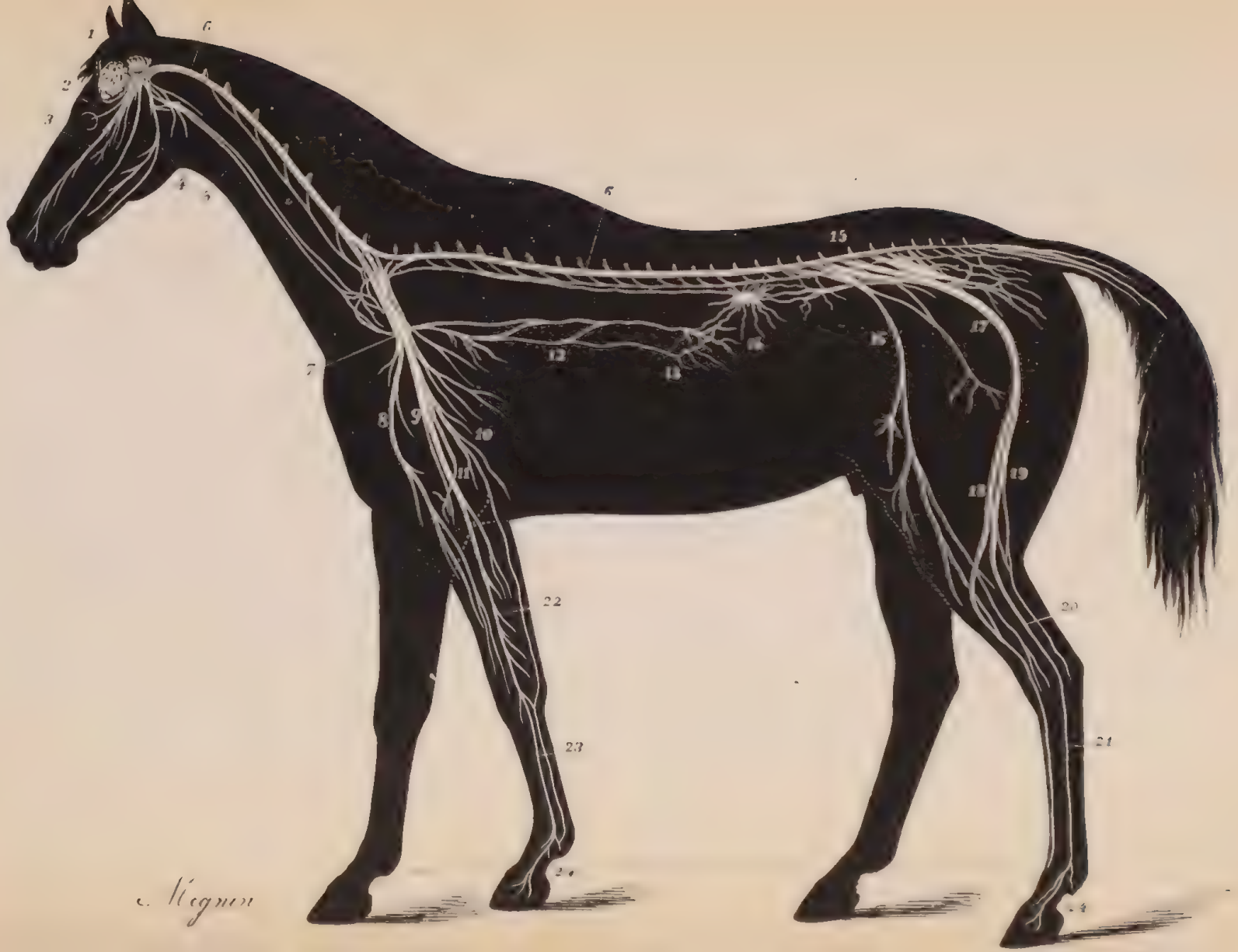
left side with this difference—that they open into the right lymphatic duct.

LYMPHATICS OF THE HEAD.

These vessels originate from the various portions of the head, and in their course downwards pass through two groups of glands, one of which is situated beneath the tongue, *sub-lingual*, the other between the rami of the lower jaw, *guttural*. From these glands the vessels descend the neck upon the trachea in company with the veins, those of the left side opening into the thoracic duct, and those upon the right side into the right lymphatic duct.

THE RIGHT LYMPHATIC DUCT.

This is a short vessel which receives the lymphatics of the right extremity, right axillary region, right superficial costal region, and the right side of the head and neck. It opens into the anterior vena cava at the junction of the two jugulars; upon the right side of the thoracic duct its orifice is guarded by a valve.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L. Wagner

PLATE 5.—NERVOUS SYSTEM.

With the exception of the spinal cord and the corresponding portion of the great sympathetic, as with the blood-vessels, all the other nerves are double and symmetrical, being found in each side of the body.

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1. Brain.
2. Optic nerve.
3. Superior maxillary nerves.
4. Inferior maxillary nerves.
5. Par vagum of pneumogastric, &c.
6. Spinal cord.
7. Brachial plexus.
8. Prehumeral nerve.
9. Anterior brachial.
10. Radial nerve.
11. Cubital nerve.
12. Pneumogastric nerve.
13. Gastric portion of the solar plexus.
14. Semilunar ganglion—the centre of the solar plexus.
15. Sacro-lumbar plexus.
16. Anterior femoral and saphena nerves.
17. Sciatic trunk.
18. Small femoro-popliteal nerve.
19. Great femoro-popliteal nerve.
20. Posterior internal tibial nerve.
21. Posterior plantar nerve.
22. Internal radial nerve.
23. Anterior plantar nerve.
24. Plantar nerves.

NERVOUS SYSTEM.

The **nervous system** *(plate 5)* consists of the *brain* and *spinal cord—cerebro spinal axis; cerebral* and *spinal nerves*, and the *sympathetic ganglionic* system. The different organs of this system are composed of two structures—the vesicular, *grey or cineritious*, and the fibrous, *white matter*. The *vesicular* is chiefly found upon the exterior of the brain and the centre of the spinal cord. It consists of vesicles which contain nuclei, and at times nucleoli. The vesicles are of various forms—stellate, ovoid, and spherical. The stellate have tail-like projections which become continuous with the nerve-fibres. The *fibrous* or white matter is of two kinds—tubular, *white*, and gelatinous; the *tubular* is formed of a central transparent portion, *axis cylinder*, and an outer portion, opaque and granular. The *gelatinous* fibres constitute the bulk of the sympathetic system also found in the cerebro-spinal nerves; they are of a yellowish colour containing nuclei.

The **nerves** are divided into two great groups—the *cerebro-spinal* and the *sympathetic*. The former are enclosed in an homogeneous sheath, *neurilemma*, and are termed the nerves of animal life; the latter the nerves of organic life.

A *nerve* possesses a definite number of fibres at its origin, and has neither more nor less at its termination in the whole of its course however long; there is no branching nor anastomosis, nor union with the substance of any other fibre: it continues to maintain its distinct individuality. Where a number of nerves meet and form an intricate network it is termed a *plexus*. *Plexuses* insure more harmonious action, and if one nerve should be destroyed they prevent loss of motion or sensation.

A *ganglion* is a nerve-centre, and consists of a collection of vesicular matter traversed by nerve fibres and covered by a capsule.

MEMBRANES OF THE BRAIN AND SPINAL CORD.

Three membranes cover the brain and spinal cord. 1.—External *dura mater*. 2.—Middle *arachnoid*. 3.—Internal *pia mater*. The **external** is composed of a dense layer of white fibrous tissue, and lined by the parietal portion of the middle coat. This membrane forms the internal periosteum of the cranial bones, and is continuous with the sclerotic coat and ocular case by the sheath of the optic nerve. It forms three processes—the *falx cerebri*, *tentorium*, and one of a circular form which surrounds the pituitary gland. The **falx cerebri** is lodged in the fissure between the hemispheres of the cerebrum, attached anteriorly to the crista galli and posteriorly to the occipital protuberance. The **tentorium** is placed between the cerebellum and the posterior lobes of the cerebrum; its attached border is convex and connected to the parieto-temporal ridge; the free margin is concave, and notched for the passage of the crura cerebri. The **circular process** surrounds the pituitary gland and is connected to the margin of the sella Turcica.

The *dura mater* of the spinal cord begins at the foramen magnum and terminates in a slender process within the caudal portion of the canal. Its outer surface is separated from the osseous walls by the inferior common ligament, blood-vessels, fat, and cellular tissue; its inner surface is related to the arachnoid membrane; opposite the intervertebral foramina it presents on both sides small apertures for the passage of the spinal nerves. The *middle membrane* is a delicate serous sac composed of two layers; the outer layer, *parietal*, is related to the dura mater, the inner, *visceral*, to the internal coat or pia mater; the

space between its layers contains a quantity of fluid. The visceral layer of the arachnoid is separated from the pia mater at the base of the brain by a space, *sub-arachnoid*, which is continuous with another formed between the pia mater and arachnoid sac of the spinal cord. The sub-arachnoid space of the cranial and spinal cavities also contains a quantity of fluid. The *internal layer* is an areolar vascular web, investing the surface of the brain and spinal cord. It is reflected into the lateral ventricles of the brain, *velum interpositum*, by the transverse fissure of the cerebrum. In the spinal canal it forms upon each side of the cord, in the spaces between the roots of the spinal nerves, a serrated ligament, *ligamentum denticulatum*, which is attached by its apices to the dura mater.

SPINAL CORD OR MEDULLA OBLONGATA.

The **spinal cord** *(plate 5, no. 6)* is formed by the reciprocal continuation of the medullary substances of the *cerebrum* and *cerebellum* by two portions from each; it proceeds upward and backward to the edge of the foramen magnum, and terminates upon the first segment of the sacrum. It presents two surfaces, two borders, and two extremities. The surfaces are slightly flattened, and each contains a furrow. The borders are slightly rounded, and also present two slight furrows from which arise the superior and inferior roots of the spinal nerves. The portions of the cord situated between the superior roots and the superior groove are termed the *superior columns;* those between the two roots the *lateral columns;* and the portions between the inferior roots and inferior groove are called the *inferior columns* of the cord. The anterior extremity is continuous with the medulla oblongata; the posterior extremity is conical and surrounded by a bundle of nerves, *cauda equina.* The spinal cord presents two enlargements—one, *brachial bulb*, at the inferior part of

the neck, and the other, *crural bulb*, in the middle of the lumbar region.

Structure.—The cord is composed of white longitudinal fibres externally, and of a few connected series of ganglia internally. The two halves of the cord are connected to each other by commissures which consist of a central portion formed of grey matter, and of an inferior and superior composed of white fibres. The inferior columns decussate only at the inferior pyramids of the medulla oblongata. The superior columns decussate throughout their entire length.

BRAIN.

The **brain** (*plate 5, no. 1*) is situated within the cranial cavity. It is divided into four portions, viz.:—the *cerebrum*, *cerebellum*, *pons Varolii*, and *medulla oblongata*.

The **cerebrum**, the first and largest portion, consists of two lateral hemispheres separated from each other superiorly by a fissure. Each hemisphere is ovoid in form and presents four surfaces and two extremities. The superior surface is convex and covered by the membranes; the external surface is also convex; the internal surface is flattened and separated from its fellow by the *falx cerebri* (a process of the dura mater) and the inferior surface is irregularly flattened and rests upon the sphenoid bone. The posterior extremity is rounded and separated from the cerebellum by the *tentorium*, and the anterior extremity is lodged in the *ethmoid fossa*. Each hemisphere is convoluted upon its superior surface and presents inferiorly, from before backwards, the olfactory lobe, fissure of Sylvius, and the mastoid lobe. The *olfactory lobe* contains a central cavity, and rests in the ethmoid fossa. It begins posteriorly by two roots—an external and internal, which arise from the inner surface of the hemisphere. Between these roots exists the anterior perforated space. The *fissure of*

Sylvius separates the olfactory from the mastoid lobe; it lodges the middle cerebral artery. The *mastoid lobe* is bounded anteriorly by the fissure of Sylvius; posteriorly it blends with the posterior part of the hemisphere.

Structure.—The cerebral hemispheres are composed of grey matter externally and white internally; they are connected to each other by a thick layer, *corpus callosum* (seen on separating the hemispheres), of transverse fibres. The superior surface of the corpus callosum is covered by the hemispheres, and contains a central raphe bounded on each side by a white cord, *corda-longitudinalis Lancisii.* The inferior surface is concave, and forms the roof of the ventricular cavity. The anterior extremity is curved downwards, and terminates in a point in front of the optic commissure. The posterior extremity is rounded and is continuous with the fornix.

Upon the *base* of the brain is situated a space *inter-peduncular*, bounded by the diverging crura cerebri laterally, pons Varolii posteriorly, and the optic commissures anteriorly; in this lozenge-shaped space are found from before backwards the tuber cinereum, corpus albicans, pons Tarini, and pituitary body. The *tuber cinereum* is a grey eminence situated between the optic tracts; it forms the floor of the third ventricle, and is connected to the pituitary gland by a tubular process, *infundibulum.* The *corpus albicans* is a rounded body placed behind the former structure, composed of white matter externally and grey internally; the former is derived from the fornix. The *pons Tarini* is a grey substance seen in front of the pons Varolii; it is perforated for the passage of blood-vessels. The *pituitary body* is oval in form, and is lodged in the sella Turcica of the sphenoid bone; it is attached to the tuber cinereum by the infundibulum.

The *ventricular cavity* is divided into two lateral portions by a median partition, *septum lucidum.* Each

lateral ventricle is an elongated cavity, and upon the floor of each is seen from before backwards the corpus striatum, tænia semi-circularis, choroid plexus, and hippocampus. The *septum lucidum* is connected superiorly to the corpus callosum, and inferiorly to the body of the fornix. It is formed of two thin layers of cerebral substance. The *corpus striatum* is a pyriform mass, situated in the anterior portion of the lateral ventricle; its exterior has a grey striped appearance; the interior is white, and is continuous with the crura cerebri. The *tænia semi-circularis* is a narrow white band situated between the corpus striatum and thalami optici. The *choroid plexus* is a vascular fringe derived from the pia mater, situated across the floor of the lateral ventricle; it passes into the third ventricle by the foramen of Munro.

The *crura cerebri* are two white cords which arise from the pons Varolii and diverge as they proceed forwards to enter the corpora striata. Each crus contains a nodule of grey matter, *locus niger*.

The *hippocampus* is derived from one of the convolutions of the cerebrum. It is lodged in that part of the ventricle contained in the mastoid lobe; along its inner border is placed a narrow white band (*tænia hippocampi*). It is related to its fellow in the median line below the body of the fornix, and is separated from the optic thalamus by the choroid plexus.

The *fornix* is a triangular-shaped body situated beneath the corpus callosum, bifurcated anteriorly and posteriorly. The former curves down to the base of the brain, terminating in the corpus albicans; its forms the anterior boundary of the foramen of Munro. The posterior pillars diverge as they proceed downwards, each becoming blended with the hippocampus in the terminal portion of the lateral ventricle.

The *thalami optici* are situated above the crura cerebri

in front of the corpora quadrigemina. They are separated superiorly from the hippocampi by the velum interpositum, anteriorly from the corpora striata by a groove, and posteriorly they are connected to the nates. Each optic thalamus presents two small eminences, the external and internal geniculate bodies.

The *third ventricle* is situated between the thalami optici and above the structures in the inter-peduncular space. It communicates anteriorly with the lateral ventricle by the foramen of Munro, and posteriorly with the fourth ventricle by the fissure of Sylvius. This cavity is crossed by three commissures—an *anterior* and *posterior* formed of white matter, and a *middle* one formed by the grey matter of the thalami optici.

The *corpora quadrigemina* consist of four rounded eminences — the anterior pair, *nates*, and the posterior pair, *testes*; the former are composed of grey matter and covered chiefly by the hemispheres of the cerebrum. The latter are connected to the anterior pillars of the cerebellum.

The *pineal gland* is situated in front of the nates, and is attached to the thalami optici by two bands, *peduncles*. It contains a gritty substance.

The *velum interpositum* is a fold of the pia mater which becomes continuous with the choroid plexus of the lateral ventricles by the transverse fissure of the cerebrum. This fissure, *foramen of Bichat*, is formed between the posterior extremity of the corpus callosum and the corpora quadrigemina.

CEREBELLUM.

The **cerebellum** is situated behind the cerebrum and placed in the fossæ of the occiput. It is formed of three lobes which are separated from each other by two well-marked grooves; the middle lobe, *vermiform process*, the

largest of the three, is subdivided by a hollow, *vallecula*, into an anterior and posterior portion. The cerebellum is connected to the testes by two processes, *anterior crura*, to the pons Varolii by two *middle crura*, and to the medulla oblongata by two *posterior crura*; the anterior crura are connected to each other by a thin layer of white matter, *valve of Vieussens*; the posterior crura are also connected by a fold of the pia mater, *valve of Renault*, which covers the calamus scriptorius of the fourth ventricle; the middle crura forms a portion of the lateral boundary of the fourth ventricle. The substance of the cerebellum consists of alternate laminæ of grey and white nervous matter, and presents upon a section a foliated appearance, *arbor vitæ cerebelli*; situated in the centre of this structure is a grey body, *corpus dentatum*.

PONS VAROLII.

The **pons Varolii** is the bond of union of the various divisions of the encephalon, connecting the cerebrum anteriorly, the medulla oblongata posteriorly, and the cerebellum above. It consists of a thick transverse band of white fibres which surround the part where the *crura cerebri* become continuous with the *medulla oblongata*. This band becomes constricted on each side, and is continued upwards as the middle crura of the cerebellum.

Structure.—Alternate layers of transverse and longitudinal fibres intermixed with grey matter.

MEDULLA OBLONGATA.

The **medulla oblongata** is the anterior enlarged portion of the spinal cord, and extends from the posterior surface of the occiput to the posterior border of the *pons Varolii*. It is pyramidal in form with its base anteriorly, and presents four surfaces for consideration. Its inferior

surface rests on the basilar process, and presents a furrow which divides it into two parts, *inferior pyramids;* they decussate with each other and are continuous with the inferior columns of the spinal cord and the crura cerebri. The superior surface is covered by the cerebellum, and presents a depression of a triangular form, *calamus scriptorius*, which is bounded by the divergence of its two columns, *restiform bodies*, and becomes continuous with the cerebellum as its posterior crura. The lateral surfaces are rounded and present the origin of several nerves and a few circular fibres, *arciform*, surrounding a slight eminence resembling the olivary body of man.

The *fourth ventricle* is formed between the cerebellum, medulla oblongata, and pons Varolii; it is bounded superiorly, by the vallecula and valve of Renault; inferiorly, by the medulla oblongata and pons Varolii; and upon each side by the posterior and middle crura of the cerebellum. Its cavity communicates with the third ventricle by the aqueduct of Sylvius. This aqueduct is formed by the valve of Vieussens and the corpora quadrigemina superiorly, and the crura cerebri inferiorly. The brain is not in itself an organ of great sensibility; on the contrary, some portions of it, as the cerebrum, are nearly insensible; nor is the destruction of a small quantity of it necessarily fatal.

CRANIAL NERVES.

The cranial nerves are arranged in pairs as follows:—

Nerves of Special Sense.—The olfactory, optic, auditory, part of the glosso-pharyngeal, and the lingual branch of the fifth.

Nerves of Common Sensation.—The greater portion of the fifth and part of the glosso-pharyngeal.

NERVES OF MOTION.—Third, fourth, lesser division of the fifth, sixth, facial, and hypo-glossal.

MIXED NERVES.—Pneumogastric and spinal accessory.

First pair.—The **olfactory** nerves are very large continuations of the substance of the cerebrum, and have a sinus within their interior. They are formed of both the cortical and medullary portions of the brain, and take their origin from the anterior of the organ, passing out of the cranium through the cribriform plates of the ethmoid bone, after which they divide into filamentary twigs, which are finally ramified over the surface of the lining membrane of the nose, *Schneiderian*, by which its exquisite sensibility of smell is furnished.

Second pair *(plate 5, no. 2)*.—The **optic** arise from the corpora genticulata, optic thalami, and corpora quadrigemina. Having joined together they subsequently separate, and leave the skull by their proper foramina, each being enclosed in a sheath furnished by the dura mater; when penetrating the globe along with the ophthalmic artery the nerve is expanded into a fine network called the *retina*, to which we are indebted for the special sense of vision.

Third pair.—The **motores oculorum** arise from the inner aspect of the crura cerebri. Each nerve passes through the foramen lacerum orbitale, and gives branches to the superior, internal, and inferior recti muscles, to the retractor oculi, inferior oblique, levator palpebræ internus, and opthalmic ganglion. They are distributed to the muscles of the eye for motion only.

Fourth pair.—The **pathetic** arise from the valve of Vieussens, and pass into the orbit by the foramen patheticum, supply the superior oblique muscle, and give off branches to the lachrymal gland.

Fifth pair.—**Trigemini,** the largest cranial nerves, arise by two roots—a *sensory* and a *motor*—from the lateral aspect of the pons Varolii, in which their fibres may be

traced to the floor of the fourth ventricle and inferior columns of the cord. The sensory root is the larger of the two, and contains a semi-lunar ganglion, *Gasserian*, which is situated above the fibrous sheath of the foramen lacerum basis cranii. From this ganglion proceed two great branches, one of which unites with the motor root by the foramen lacerum basis cranii, and leaves the cranium as the *inferior maxillary nerve;* the other is directed forwards in the outer groove of the sphenoid bone, where it divides into two branches, one, *superior maxillary nerve* (*plate* 5, *no.* 3), passing through the foramen rotundum, the other, *opthalmic nerve*, passing through the foramen lacerum orbitale.

The **inferior maxillary nerve** (*plate* 5, *no.* 4), after it leaves the cranium, passes through the inferior dental foramen, and gives off numerous filaments which supply the under lip and chin. Branches as they arise in its course downwards—1. *Masseter nerve* supplies the muscle of the same name and the temporalis. 2. *Buccal nerve* supplies the muscles and mucous membrane of the cheek and molar glands. 3. *Internal pterygoid nerve* supplies the internal pterygoideus muscle. 4. *Superficial temporal nerve* gives filaments to the guttural pouch, parotid gland, temporal region, and a few fibres to the facial nerve. 5. *Lingual nerve* gives filaments to the mucous membrane of the tongue, sub-maxillary, and sub-lingual glands; it inosculates with the tympano-lingual branch of the seventh pair. 6. *Mylo-hyoideus nerve* is distributed among the muscles of the same name. 7. *Dental nerves* supply the inferior molars, tushes, and incisor teeth.

The **superior maxillary nerve** (*plate* 5, *no.* 3), after leaving the cranium, proceeds to the maxillary hiatus, where it passes through an osseous canal which it leaves by the inferior orbital foramen, its terminal branches forming an intricate plexus upon the cheek, where they

inosculate with those of the facial nerves. Branches as they arise from behind forwards—1. *Orbital nerve* supplies the eyelids. 2. *Palatine nerve* passes through the palatine canal, supplies the hard and soft palates, and gives off a few filaments which accompany the palatine artery to the roots of the incisor teeth. 3. *Staphyline nerve* gives filaments to the soft palates. 4. *Nasal nerve* supplies the Schneiderian membrane. 5. *Dental filaments* supply the roots of the molar teeth, mucous membrane of superior maxillary sinus, corner incisor teeth, and tushes. 6. *Inferior orbital plexus* supplies the muscles and integuments of the face, alæ nasi, and upper lip.

The **opthalmic nerve** divides, after it leaves the cranium, into three branches—1. *Supra-orbital nerve*, which passes through the foramen of the same name, supplies the forehead and external ear. 2. *Lachrymal nerve* gives filaments to the lachrymal gland and the structures of the anterior part of ear. 3. *Palpebro-nasal nerve* enters the cranium by the internal orbital foramen, from which it passes into the nose and becomes distributed to its mucous membrane; it gives off filaments to the inferior eyelid, lachrymal apparatus, membrana nictitans, and opthalmic ganglion.

Ganglia of the fifth pair.—The **opthalmic ganglion** is placed upon the side of the motores oculorum near to the origin of the branch that supplies the inferior oblique muscle. Its roots consist of two small branches from the third pair—one from the palpebro-nasal nerve, and a few filaments from the sympathetic. Bra.—eight or nine ciliary nerves, which are distributed to the ciliary circle and iris. The **ganglion of Meckle** is situated upon the side of the spheno-palatine nerve. Its roots consist of the vedian nerve, branches from the spheno-palatine nerve, and sympathetic. Bra.—to the muscles of the eyeball, opthalmic artery, palate, and surrounding parts. The **otic ganglion** is situated upon the side of the inferior maxillary nerve

close to the eustachian tube. Its roots consist of the superficial petrous nerve, branches from the inferior maxillary nerve, and sympathetic. BRA.—to the middle ear, eustachian tube, and pterygoidei muscles. Of the branches of the fifth nerve the opthalmic is the most motor; and the superior maxillary the most sentient. The inferior maxillary is of a mixed character.

Sixth pair.—The **abducens** arise from the medulla oblongata close to the posterior border of the pons Varolii; they leave the cranium by the foramen lacerum orbitale and supply the external rectus and a small branch to the retractor oculi.

Seventh pair.—The **facial** or **auditory nerves** consist of two portions, called *portio mollis* and *portio dura.* The former enters the auditory foramen in a soft pulpy form, and is distributed to the internal ear. The latter passes through the foramen auditorium inclosed in the same covering of the dura mater with the portio mollis; in its course it detaches a considerable branch, the *corda tympani;* leaving the internal ear by the spiral canal, it parts with branches to the inner and outer parts of the ear: the main trunk having first furnished the parotid gland, into which it dips, and, being enlarged by uniting with a branch from the maxillary, now passes over the posterior jaw, contiguous to the temporal artery, and divides, its branches diverging like the sticks of a fan, some of which are distributed to the muscles of the anterior jaw, but the principal are given to the posterior, and unite with the anterior maxillary.

The eighth pair (*plate* 5, *no.* 5). The **par vagum** or **pneumogastric** arise from the edge of the medulla oblongata in disgregated fibres in connection with another pair named the glosso-pharyngeus, sometimes described as the ninth pair. These are joined by a third from without the cranium, called spinal accessory. These three trunks,

united in one sheath, descend through the foramen lacerum of the base of the skull, and speedily divide into three branches. The first, called the **glosso-pharyngeal,** is distributed to the pharynx and base of the tongue. The par vagum then proceeds down the neck in the sheath of the carotid artery, and enters the chest. Having reached the anterior aorta it gives off the two *recurrent* nerves. The *left recurrent* winds round the posterior aorta, and then changes its course, going back again to become the *inferior laryngeal* nerve. The *right recurrent* leaves the par vagum as it passes the first ribs, and proceeds along the anterior portion of the neck to the larynx. These nerves are supposed to be the medium of furnishing vocal energy, inasmuch as a division of them effectually silences an animal. The par vagum, now left alone, proceeds onwards to supply the viscera of the chest and abdomen with sensation, blending also with the various ganglia of the sympathetic system. The par vagum is described as a mixed nerve, but its sentient branches prevail. It supplies the larynx with motion, and it also gives it exquisite sensation. It is the nerve which conveys to the brain the sense of pain, and it is so important to the economy of the horse that a division of it instantly kills. The *spinal accessory nerves*, which unite with the par vagum, derive their origin from filaments given off by the fourth and fifth spinal nerves. As they enter the skull they join the eighth, and are afterwards distributed to the muscles of the neck and sternum.

The ninth or **lingual** pair take their origin from the corpus pyramidali, and both pass through the condyloid foramen downwards along the branch of the posterior jaw to gain the root of the tongue, and seem thus to be peculiarly appropriate to its locomotion, as the lingual branch of the fifth pair are to its functional property of taste.

The tenth pair, or **sub-occipitals**, are sometimes described as a pair of spinal nerves. They arise in part from the extremity of the medulla oblongata, and passing out by the occipital holes, are distributed to the muscles of the head and neck, and in part they also arise from the medulla spinalis. Each takes its course outwards by a foramen of the atlas, separating into an upper and lower division. The upper ramifies into the muscles in its vicinity, giving a small branch over the crown of the head to the ear and parts around. The inferior division piercing a foramen in the anterior wing of the atlas, gains the trachea, ramifies around its upper portion, the thyroid gland and the muscles beneath; communicating with the cervical ganglia, and very generally with the minute branches of the neighbouring nerves, forming itself an important sympathetic medium.

PHYSIOLOGY OF THE BRAIN AND NERVES.

The physiology of the brain and nerves is an important but mysterious function, which recent researches assisted by the microscope have more fully explained.

It is stated by Dr. MAPOTHER that animals are most plainly distinguished from the other division of the organic world by this function, which controls all other physiological processes, by conveying impressions to or from nervous centres along conductors we term nerves.

The brain is a nervous centre, and the nerves are the media by which sensation and volition are transmitted to all parts of the body, and by them excitement to motions is propagated. *Neurine* or nervous matter is the agent employed in their mysterious function. It is a white or grey opaque and soft substance, mechanically supported by areolar tissue or blood-vessels. The specific gravity of the human brain is 1·039. Its composition varies at different

periods. At the adult period of life it is found to consist of—

Water	72·51
Albumen	9·40
Cerebral fat	6·10
Osmazonic and salts	5·96
Phosphorus	0·80
	100·00

Nervous matter is of two kinds, distinguished by their colour, and called *vesicular* and *tabular*.

The **vesicular neurine (grey)** covers the surface of the brain. It is softer and more vascular than white neurine, containing more water and less fat. The vesicles are large, contain a nucleus which is also cellular, possessing a bright nucleolus and much pigmentary granular matter which gives the characteristic dark grey tint. They are ovoid or spheroid in the sympathetic ganglia, and stellate or caudal in the cerebro-spinal centres.

The nerve tubes are of two kinds, *gelatinous* and *cylindrical*. The first occur in the sympathetic and special sense nerves; they are grey. The *cylindrical* nerve tubes form the great mass of the white substance of the brain, spinal cord, and nerves. They are placed parallel, and in nerves are connected by areolar tissue. The nerves convey impressions from and back again to the brain; thus the horse smells with his nose, and feels with his lips; and through the medium of the nerves of both, his intellectual powers, resident in the brain, take cognizance of the matters examined. To the organs of voluntary motion, the excitement along the nerves is dependent on the will; to the involuntary, it is dependent on necessity or sympathy connected with the wants of the animal. The functions of the brain and nerves are very apparent under certain diseased conditions. Thus if the brain be injured, locomotion is destroyed wholly or partially, in proportion to the

degree of cerebral derangement. Pressure on the brain produces the same phenomena as laceration of certain parts of it. When this organ is diseased or compressed the whole body suffers, and becomes convulsed or paralyzed; but if the spinal cord be thus circumstanced, then only those parts whose nerves are given off posteriorly to the seat of injury become affected.

In many instances the functions of the involuntary motions go on when the voluntary are stopped; as we see in animals partially stunned, and in apoplexy, where breathing and even digestion are carried on while the limbs are motionless and the animal sleeps.

SPINAL NERVES.

The **spinal nerves** *(plate 5, no. 6)* are forty-two in number upon each side. They arise by two roots — a superior, *sensory*, and an inferior, *motor*.

The **sensory root** arises from the superior columns of the cord, and presents a small ganglion close to its union with the inferior root.

The **motor root**, the smaller of the two, arises from the inferior columns of the cord. The two unite to form a common trunk, and after having pierced the dura mater pass through the inter-vertebral foramina; they there divide into two branches—the one supplying the structure above the spinal column, and the other those beneath it.

CERVICAL NERVES.

(EIGHT PAIRS.)

This includes one pair generally described as the first dorsal pair.

Superior branches.—These divisions are distributed to the muscles of the superior cervical region and temporo-auricularis muscles.

Inferior branches.—These divisions of the first six nerves form, upon the side of the neck, an intricate plexus, *superficial cervical*, which receives filaments from the spinal accessory and facial nerves. Its branches are distributed to the superior cervical region, panniculus, muscles of the external ear, and the superior and inferior cervical ganglia. The inferior branches of the seventh and eighth proceed to the brachial plexus; the seventh receives a filament from the sixth, and the eighth gives off a small branch to the inferior cervical ganglion.

DORSAL NERVES.

(SEVENTEEN PAIRS.)

Superior branches.—These ramify in the muscles and integuments of the dorso-lumbar region.

Inferior branches.—These are distributed to the thoracic parietes, and the last gives a branch to the walls of the abdomen. The first nerve joins the brachial plexus, which also receives a branch from the second. They all give off filaments to the thoracic ganglia of the sympathetic nerve.

LUMBAR NERVES.

(SIX PAIRS.)

Superior branches.—These ramify in the muscles and integuments of the loins and croup.

Inferior branches.—The branches of the first and second are distributed in the muscles of the abdomen, inner and anterior aspect of the flank, and their integuments. The third gives branches to the psoas muscle, walls of the abdomen, thigh, inguinal region, scrotum, and sheath. The third and fourth give a small branch to the inguinal nerves. The inferior branch of the fourth nerve gives off twigs to the inner and anterior aspects of the haunch, psoas magnus, lumbo-sacral plexus, and inguinal nerve of

the third pair. The fifth and sixth to the lumbo-sacral plexus. They all send filaments to the sub-lumbar ganglion of the sympathetic.

SACRAL NERVES.

(FIVE PAIRS.)

Superior branches.—These pass through the supra-sacral foramina and supply the muscles of the sacral region and integuments of the croup.

Inferior branches.—The first, second, and third enter into the formation of the **lumbo-sacral plexus**; the fourth gives off the internal pudic in the male, which accompanies the artery of the same name, and in the female it supplies the muscles of the perineo-anal region and its integuments; the fifth forms the hæmorrhoidal nerve and supplies the muscles of the anus; the fourth and fifth communicate by several filaments with the sacro-lumbar plexus.

CAUDAL NERVES.

(SIX PAIRS.)

These nerves form two cords which proceed to the extremity of the tail, giving off numerous branches in their course which ramify in the muscles and integuments. These nerves differ from the other spinal nerves in being unconnected with the sympathetic, as well as forming no plexi, and being wholly distributed to the parts they emanate from.

NERVES OF THE ANTERIOR EXTREMITY.

These nerves proceed from an intricate plexus (*plate* 5, *no.* 7), *brachial*, situated between the scapula and the outer aspect of the thorax. This plexus is composed of the inferior branches of the seventh and eighth cervical and first dorsal nerves. It receives also filaments from the

sixth cervical and second dorsal, and several from the sympathetic nerve. Bra.—1. *Filaments* to the diaphragmatic nerves. 2. *Filaments* to the rhomboidei and serratus magnus. 3. **Superior thoracic nerve** ramifies in the serratus magnus. 4. **Inferior thoracic nerves** ramify in the pectoral muscles. 5. **Subcutaneous thoracic nerve** accompanies the spur vein and ramifies in the panniculus and skin; it communicates with the external thoracic branches of the dorsal nerves. 6. A *filament* to the levator humeri (*plate* 5, *no.* 8). 7. **Axillary nerve** gives branches to the abductor muscles of the humerus, levator humeri, and integuments of the arm. 8. *Filaments* which ramify in the sub-scapularis and teres internus muscles. 9. The **external scapular nerve** supplies the antea spinatus and postea spinatus. 10. The **anterior brachial nerve** (*plate* 5, *no.* 9) supplies the coraco-radialis and humeralis muscles. 11. The **radial nerve** (*plate* 5, *no.* 10) proceeds downwards to the fore-arm, where it terminates in the extensor metacarpi obliquus and gives branches to the triceps extensor brachii, flexor metacarpi externus, extensor muscles of the metacarpus and foot, and integuments of fore-arm. 12. The **cubital nerve** (*plate* 5, *no.* 11) passes down the posterior aspect of the fore-arm to the knee, where it terminates in two branches; one giving a filament to the sterno-aponeuroticus, skin of fore-arm, and flexor muscles of metacarpus; the other uniting with a filament of the median nerve to form the external plantar nerve. 13. The **median nerve** (*plate* 5, *no.* 22) a little below its origin, forms an anastomosis with the anterior brachial, and accompanies the posterior radial artery down to near the knee joint, where it bifurcates to form the plantar nerves; it gives branches to the superficial pectoral muscles, humeralis externus, coraco-radialis, and flexor muscles of the foot.

Plantar nerves (*plate* 5, *nos.* 23 *and* 24). The *internal*

nerve is derived from the median, and the *external* from a branch derived from the cubital and a filament from the median nerves. They pass down upon the outer and inner borders of the tendons of the flexor muscles to the fetlock, where they terminate in the *digital nerves*. They give off filaments to the structure of the metacarpal region. The internal gives off, near the canon bone, a branch which crosses obliquely behind the flexor tendons to join the nerve on the other side.

The **digital nerves** are three—an *anterior*, *middle*, and *posterior*. The **anterior** ramifies in the skin on the anterior aspect of the phalanges and coronary band; the **middle** to the fetlock joint and sensitive laminæ; the **posterior**, the largest of the three, accompanies the digital artery to the foot, terminating in the preplantar fissure by numerous filaments which terminate in the os pedis and laminæ. It gives off branches to the posterior part of the fetlock joint, frog, lateral cartilages, sensitive laminæ, and a branch which enters the plantar foramen and ramifies among the blood-vessels of the semi-lunar sinus.

NERVES OF THE POSTERIOR EXTREMITY.

These *nerves* are derived from a large plexus, *sacro-lumbar*, (*plate* 5, *no.* 15) situated in the sub-lumbar and pelvic region. They consist of two portions, an anterior and a posterior, which communicate with each other by one or two branches. The *posterior portion* is formed by the inferior branches of the fifth and sixth lumbar nerves, and a small branch from the fourth. The *anterior portion* is formed by the first three sacral nerves. Bra.—several *filaments* which accompany the divisions of the ilio-muscular artery. The **crural nerve** arises from the anterior portion of the plexus and terminates in the triceps cruralis muscle; it gives filaments to the skin upon the inside of the thigh as far down as the hock joint, and they accompany the

saphena vein and supply the adductors of this region. The **obturator nerve** arises from the anterior part of the plexus ; it passes through the obturator foramen and ramifies amongst the muscles upon the inside of the thigh. The **gluteal nerves** are given off from the posterior portion of the plexus, and supply the gluteal, semi-tendinosis, and semi-membranosis muscles. The **great sciatic nerve** (*plate* 5, *no.* 17) leaves the pelvis by the sacro-sciatic notch and descends upon the postero-external aspect of the leg near to the os calcis, where it divides into the *anterior*, the *posterior tibial*, and into *popliteal* twigs. The **posterior tibial** (*plate* 5, *no.* 20) and principal branch, passing between the fleshy portions of the gastrocnemii, gains the hock, where it travels to one side of the perforans tendon, and separating, forms the two metatarsal nerves. The **popliteal**, which consists of a great number of fine twigs, is distributed principally to the muscles at the back of the stifle joint, and to the joint itself. The **external saphena nerve** (*plate* 5, *no.* 16) accompanies the vein of the same name, and is distributed to the skin upon the outer aspect of the leg, metatarsus, and phalangeal regions. The **small sciatic nerve** descends to the stifle joint, where it terminates as the *musculo-cutaneous* and *anterior tibial* nerves ; it gives branches to the haunch and leg. The **musculo-cutaneous nerve** ramifies in the peroneus and extensor pedis, and integuments of the anterior aspect of leg and metatarsus. The **anterior tibial nerve** gives branches to the extensor pedis and flexor metatarsi muscles, and one which descends with the anterior metatarsal artery to the fetlock, and there supplies the skin. The **plantar nerves** (*plate* 5, *nos.* 21, 23, *and* 24) descend the fetlock similarly to those of the anterior extremity.

SYMPATHETIC NERVE.

The **sympathetic nerve** consists of a series of ganglia

connected to each other, placed beneath the vertebral column, and extending from the cranium to the pelvis. Each ganglion may be considered as a distinct centre. This nerve is divided into five portions—the *cephalic, cervical, dorsal, lumbar*, and *sacral*.

The **cephalic portion** consists of the ganglia upon the divisions of the trifacial nerve.

The **cervical portion** is composed of two ganglia—a *superior* and *inferior*, connected to each other by a nervous cord. The **superior ganglion** is situated upon the side of the internal carotid artery ; its branches are derived from the ninth, tenth, eleventh, and twelfth pairs of cranial nerves and the first cervical. Its branches form two plexi, one of which, *carotid*, accompanies the divisions of the carotid artery, the other, *guttural*, ramifies upon the pharynx and guttural pouch. The **inferior ganglion** is placed upon the inner aspect of the scalenus muscle ; its branches are two, one of which is situated in the vertebral foramen, and is formed by fibres from the second, third, fourth, fifth, sixth, and seventh cervical nerves ; the other is formed by the eighth cervical nerve. Their branches form a plexus, *tracheal*, which supplies the inferior surface of the trachea ; it gives off numerous filaments to the heart.

The **dorsal portion** consists of seventeen ganglia, placed in the inter-costal spaces and connected to each other ; the branches of these ganglia are derived from the inferior divisions of the dorsal nerves ; it gives off the *greater* and *lesser splanchnic nerves* and a few filaments to the pleura. The **great splanchnic nerve** is formed by filaments derived from the sixth, seventh, eighth, ninth, tenth, eleventh, twelfth, thirteenth, and fourteenth ganglia ; it enters the abdomen and forms the *semi-lunar ganglion* (*plate* 5, *no.* 14). The **semi-lunar ganglion** is placed upon the side of the anterior mesenteric artery, behind which it communicates with the ganglia of the other side and numerous filaments

which cross the inferior aspect of the posterior aorta, and there form the solar plexus; this plexus receives branches from the pneumogastric (*plate* 5, *no.* 12). It gives off branches to the stomach, *gastric plexus* (*plate* 5, *no.* 13); to the liver, *hepatic plexus;* to the spleen, *splenic plexus*; to the mesentery, *mesenteric plexus;* to the kidneys, *renal plexus;* to the supra-renal capsules, *supra-renal plexus;* and the lumbar plexus, which is situated in the lumbar region beneath the aorta. The **lesser splanchnic nerve** is derived from the last three dorsal ganglia and a few filaments from the greater. It communicates with the solar plexus and terminates in the renal plexus.

The **lumbar portion** consists of six ganglia placed on each side of the inferior common vertebral ligament; its branches arise from the inferior division of the lumbar nerves. It gives off branches which unite with the lumbar plexus (*plate* 5, *no.* 15) to constitute the posterior mesenteric plexus which supplies the organs contained in the pelvic cavity.

The **sacral portion** consists of four ganglia, which receive branches from the sacro-spinal nerves and give off filaments to the pelvic plexus. The sympathetic nerve terminates by anastomosis upon the middle coccygeal artery by several filaments derived from the last two sacral ganglia.

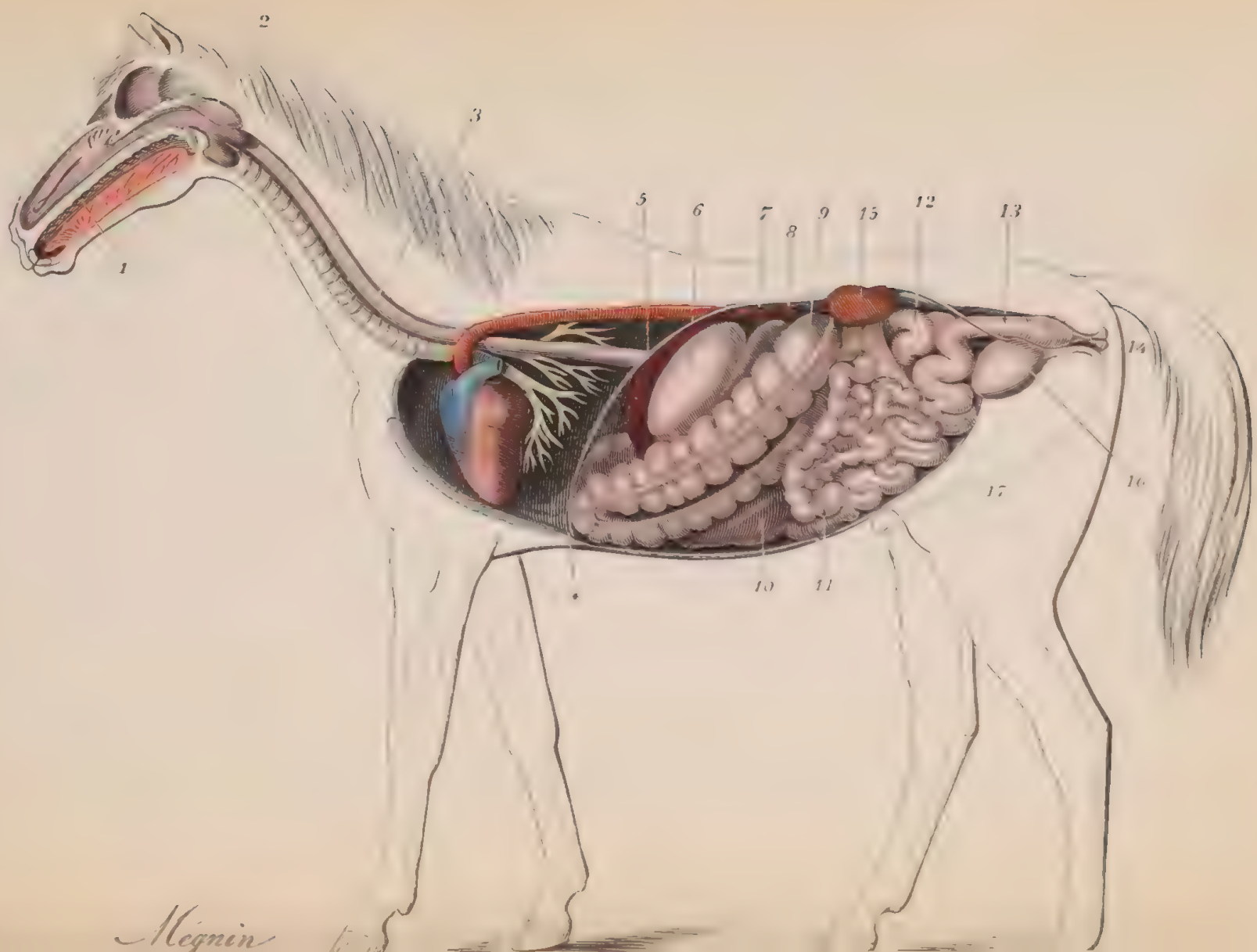
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PLATE 6.—DIGESTIVE APPARATUS.

1. Mouth.
2. Pharynx.
3. Œsophagus.
4. Diaphragm.
5. Spleen.
6. Stomach.
7. Duodenum.
8. Liver, upper extremity.
9. Large colon.
10. Cœcum.
11. Small intestine.
12. Floating colon.
13. Rectum.
14. Anus.
15. Left kidney and its ureter.
16. Bladder.
17. Urethra.

DIGESTIVE APPARATUS.

This apparatus consists of a series of hollow organs which receive and digest the food. These cavities are the *mouth*, *pharynx*, *œsophagus*, *stomach*, and *intestine*.

The **mouth** (*plate* 6, *no.* 1) is quadrangular in form and elongated from before backwards. It is bounded anteriorly by the lips, posteriorly by the pharynx and larynx, superiorly by the palate, inferiorly by the mylo-hyoideus, and on each side by the cheeks. This cavity contains the teeth, tongue, and soft palate; it is lined by a mucous membrane, *buccal*, which varies in character at different parts. It is reflected upon the various organs contained within the mouth, and is continuous with the skin anteriorly, and with the mucous membrane of the pharynx, larynx, and nose posteriorly.

The **lips** are two in number—a superior and an inferior. Each is formed of the labial muscles inter-mixed with connective tissue, and covered externally by the skin, internally by the buccal membrane. The upper lip is the larger and more mobile of the two; it presents numerous small papillæ externally, and the orifices of numerous mucous glands internally.

The **tongue** is a musculo-membranous organ placed upon the floor of the mouth; it is bounded laterally by the lower molar teeth, and anteriorly by the inferior incisors. This organ is elongated from before backwards; thick and prismatic at its base, *root*, thin and slightly expanded at its apex. It is connected to the hyoid bone and lower jaw by the lingual muscles. Its membranous portion is a reflection of the mucous membrane of the mouth. Upon its superior surface exists a median furrow, *raphæ;* and it is everywhere studded with *papillæ*, which are divided into

four varieties—those that are thread-like, **filiform**; those resembling a mushroom, **fungiform**; those situated in recesses, **circumvallate**; and the **conical**, which are the most numerous. Where its membranous covering becomes continuous with that of the mouth inferiorly it forms an ample fold, **frenum linguæ.**

The **cheeks** form the lateral aspect of the face, and are continuous anteriorly with the lips. They are composed of the skin, buccal membrane, muscular tissue, fat, nerves, blood-vessels, and small salivary and mucous glands.

The **gums** are composed of a dense layer of white fibrous tissue, which is closely adherent to the periosteum of the alveolar processes, and is covered by a reflection of the buccal membrane, which is thin, smooth, and very vascular.

The **palate** is formed of two parts—a *hard* and a *soft* portion. The **hard palate** forms the roof of the mouth, and consists of the palatine processes of the superior maxillary and palatine bones, which are covered upon their inferior aspect by a thick layer of white fibrous tissue. This tissue, with its covering of mucous membrane, is thrown into a number of transverse ridges, **bars,** which gradually disappear posteriorly. The **soft palate** is a musculo-membranous partition separating the mouth from the posterior nares and pharyngeal cavity. It is attached by its superior part to the semi-lunar border of the hard palate; its inferior border is free.

The **teeth** are forty in number, twenty being placed in each jaw. They are divided into three classes—twelve **incisors** or cutting teeth; twenty-four **molars** or grinding teeth; and four **canine** teeth or tushes. A **tooth** consists of a crown which projects above the gum, and of a root or fang which is implanted in an alveolus. The dental substance is composed of three elements—*enamel*, *dentine*, and *crusta petrosa*. The **enamel** is the hardest of the three, and is formed of minute hexagonal rods placed upon

the surface of the dentine and firmly united to each other. The **dentine** is composed of fine tubes running from a central hollow, *pulp cavity*, in the tooth to the enamel or crusta petrosa. The **crustra petrosa** is similar in structure to bone; it covers the exterior of the fang and tends to fix it in the alveolus. The crowns of the teeth of the horse present the three dental constituents upon their wearing surfaces, and therefore the teeth are said to be compound. In simple teeth the crowns are formed of enamel only. The mare rarely possesses tushes, although they are sometimes found in a very rudimentary form.

SALIVARY APPARATUS.

The **salivary apparatus** consists of a number of *glands* which form a secretion and discharge it into the buccal cavity. They are divided into two groups—an *intrinsic* and an *extrinsic*. The former includes the **labial glands** upon the lips, the **buccal** upon the cheeks, and the pharyngeal. A number of the buccal glands form, upon each side of the mouth, a group, **molar glands,** which are placed opposite the last three superior molar teeth. The **extrinsic** glands are three in number on each side.

The **parotid**, the largest of the three, is situated below the ear and behind the border of the lower jaw. It gives off from its inferior part a long duct, *Steno's*, which passes forwards upon the inner aspect of the lower jaw, curves round its inferior border in front of the masseter muscle, and opens into the mouth opposite the second superior molar tooth.

The **sub-maxillary gland** is placed between the ramus of the lower jaw and the trachea, where it is loosely connected to the surrounding parts by connective tissue. The duct, *Whartonian*, of this gland arises near its centre and creeps along the lower border of the sub-lingual gland, opening by a small perforated eminence, **barb,** upon the lateral aspect of the frenum linguæ.

The **sub-lingual gland,** the smallest of the three, is situated beneath the tongue. It is elongated from before backwards, and gives off from its upper border a number of ducts, *Rivinian*, which open into the mouth upon the side of the frænum linguæ.

The *structure* of the salivary glands is similar in all; each consists of a variable number of minute vesicles collected into lobules and held together by connective tissue and blood-vessels; these vesicles communicate with each other by means of a common excretory canal, **duct,** which is formed of two coats—an *external*, composed of white fibrous tissue intermixed with muscular fibres, and an *internal* mucous membrane. In the horse, cow, and some other animals, each side of the jaw and salivary glands is used alternately. The flow of saliva is promoted by the motions of the jaw and by nervous influence. The saliva of the horse has been analysed by *Lassaigne*. It afforded 3·5 per cent. of solid residue, and deposited carbonate and phosphate of lime.

PHARYNX.

The **pharynx** *(plate* 6, *no.* 2) is an organ common to the digestive and respiratory tracts. It is related superiorly to the base of the cranium, inferiorly to the larynx, and laterally to the hyoidean and pterygoidei muscles. It communicates anteriorly with the mouth, posteriorly with the œsophagus, superiorly with the posterior nares, inferiorly with the larynx, and laterally with the Eustachian tubes. This organ is formed of muscular tissue and a mucous membrane which lines its internal surface.

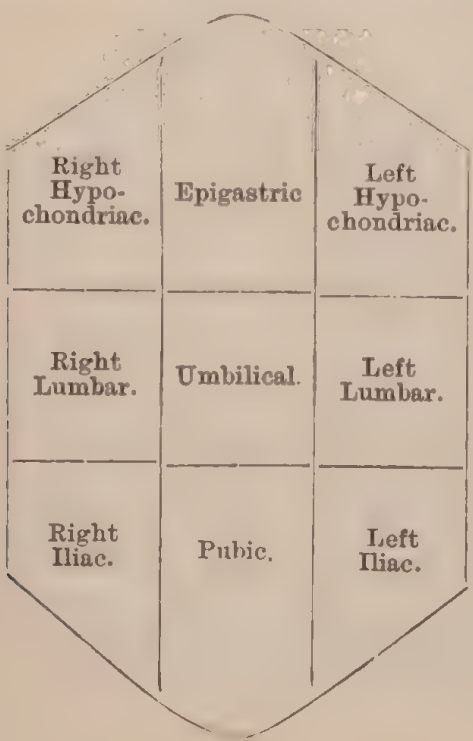
ŒSOPHAGUS.

The **œsophagus** *(plate* 6, *no.* 3) is a tube connecting the pharynx with the stomach. It is placed above and to the left side of the trachea, and covered externally by muscles; in the thorax it passes over the base of the heart, and

enters the abdomen by the foramen sinistrum, where it becomes connected to the cardiac extremity of the stomach. It is formed of two coats—an *external muscular* and *internal mucous;* the former is composed of two layers, an external longitudinal and an internal circular, the fibres of the latter intersecting each other in an oblique direction. The **mucous coat** presents a number of longitudinal folds, **rugæ,** and has a greyish colour; it contains a number of mucous glands.

ABDOMEN.

In order that the position of the organs contained in the abdomen may be better understood, this cavity is subdivided into regions in the following manner:—an imaginary transverse line is drawn from the cartilage of the last rib upon the one side to that of the other side, another from the external angles of the two iliac bones, and a longitudinal one on each side from the cartilage of the last true rib to the centre of Poupart's ligament. These lines divide the abdominal cavity into nine regions, as follows:—



PERITONEUM.

The abdominal organs are covered by a serous membrane, **peritoneum**, which lines the inner aspect of the abdomen, and is formed of two layers—an outer, **parietal**, attached to the abdominal walls, and an inner **visceral** attached to the abdominal viscera. The space between these layers, **peritoneal sac**, is closed in the male, but communicates with the uterus in the female by the fallopian tubes. It is arranged in folds, the largest of which, **mesentery**, suspends the small intestine from the vertebral column; the other reflections tend to connect the organs to each other. One large fold, **great omentum**, is reflected from the stomach and transverse colon; it frequently contains a large quantity of fat. The cavity of this omentum communicates with the general peritoneal sac by a passage, **foramen of Winslow.** Along the borders of the colon the peritoneum presents a number of pouches filled with fat, **appendices epiploicæ.** The interior of the peritoneal sac is kept smooth and moist by a small quantity of fluid.

STOMACH.

The **stomach** (*plate* 6, *no.* 6) is situated in the epigastric and left hypochondriac regions. It is retained in its position by four ligaments formed by reflections of the peritoneum — the *gastro-phrenic*, *gastro-hepatic*, *gastro-splenic*, and *gastro-colic omenta;* besides these ligaments it is connected to the œsophagus and duodenum by its extremities. The stomach presents two surfaces; two borders, a greater and a lesser; and two extremities. The surfaces are convex and smooth. The *greater border* is convex, and is applied in part to the colon and spleen; the *lesser border* is concave, and is directed upwards and forwards towards the liver. The *left extremity*, **cardiac**, is connected to the œsophagus, near which union the convex

border presents a dilation, **great fundus**; the *right extremity*, **pyloric,** is continuous with the duodenum, near which it presents another dilation, **antrum pylori.**

Structure. — Composed of three coats — an external, **serous** or **peritoneal**; a middle, **muscular,** formed of three layers—longitudinal, circular, and oblique; and an internal coat, **mucous,** which is thrown into numerous folds, **rugæ,** which are largest in the cardiac extremity. The mucous membrane in the right half of the stomach is of a red colour, and presents the orifices of numerous follicles, **peptic glands**; in the left half the membrane is white, due to a thick layer of scaly epithelium; it only contains mucous glands. The pyloris is guarded by a valve, **pyloric,** which is formed by a doubling of the mucous membrane and a few muscular fibres. From the internal coats of the stomach is secreted the **gastric juice,** so necessary for digestion. It is a colourless slightly viscid fluid, with a sour smell and intensely acid reaction, and has been found to contain water, pepsin, hydrochloric acid, chlorides, and phosphates in various proportions.

INTESTINE.

The **intestine** consists of two parts of unequal size. The smaller, which is about seventy-two feet in length, is divided into three arbitrary portions—*duodenum*, *jejunum*, and *ilium*. The **duodenum** (*plate* 6, *no.* 7), the shortest but widest of the three divisions, arises from the pyloric extremity of the stomach, from which it curves to the right side and crosses the spine behind the great mesenteric artery, becoming continuous with the jejunum in the left lumbar region. The **jejunum** possesses numerous convolutions, which are located chiefly in the umbilical and left iliac regions, in the latter of which it terminates in the ilium. The **ilium** (*plate* 6, *no.* 11) is the narrowest but the longest and most convoluted portion of the small

intestine; it ends in the right iliac region by opening into the commencement of the large intestine.

The large intestine, which is about twenty-three feet in length, is also conventionally divided into three parts—the *cæcum*, *colon*, and *rectum*. The **cæcum** (*plate* 6, *no.* 10) is a conical pouch arising in the right iliac region from which it passes obliquely forwards and downwards to the left hypochondriac region, in which its apex is free. The **colon** (*plate* 6, *no.* 9) comprises three portions—the double, transverse, and the single or floating colon (*plate* 6, *no.* 12). It arises with the cæcum in the right iliac region, from which it passes forwards to cross the spine behind the diaphragm, and is continued back to the left iliac region where it turns upon itself, forming the sigmoid flexure. From this curve it passes forwards above the other portion and crosses again over to the right side, when it runs backwards to near its starting point, **right iliac**, from which it curves forwards and across the spine again in front of the anterior mesenteric artery, when it becomes the *single colon*; that part situated in front of the great mesenteric artery is termed the *transverse colon*, and that portion intervening between its origin and the latter the double colon; the single colon proceeds backwards upon the left side of the vertebral column to the base of the sacrum, where it becomes continuous with the rectum. The **rectum** (*plate* 6, *no.* 13) passes straight backwards to the anus (*plate* 6, *no.* 14); it is slightly curved, presenting its convexity superiorly where it is applied against the sacrum.

Structure.—The intestine is composed of three coats—an external *serous*, a middle *muscular* and an internal *mucous* coat. The **serous, peritoneal,** is connected to the muscular coat by areolar tissue; where it is reflected from the upper or attached border of the intestine it leaves a small triangular space which contains the blood-vessels, nerves, and lymphatics. The **muscular** coat consists of two

layers—an external longitudinal and an internal circular. The **longitudinal layer** presents a uniform covering to the small intestine, but in the large it is collected into bands which vary from one to four in number; these bands corrugate the intestine into pouches, which are however absent upon the apex of the cœcum and posterior two thirds of the rectum. The **circular layer** of fibres is thickest in the ilium in the small intestine; and in the large it is thickest at the posterior part of the rectum, where it forms a thick layer, **internal sphincter ani.** The **mucous** coat is connected to the muscular by cellular tissue. In the small intestine this membrane is peculiar in being studded with villi, which are small conical vascular eminences similar in structure to the mucous membrane, and containing a rootlet of the lacteal vessels in their centre. The glands of the small intestine are situated in the submucous tissue. They consist of small racemose glands, **Brunner's,** found only in the duodenum; of follicles, **Lieberkuhnian,** found throughout the whole intestine; and of minute ductless glands, which are of two kinds: **solitary,** found in the small and large intestine, and those existing in groups, **Peyer's patches,** found in the jejunum and ilium. The mucous membrane is thrown into folds at different parts, one of which closes the openings of the biliary and pancreatic ducts which exist upon the upper aspect of the duodenum, about five inches from the pyloris. The opening, **ileo-cœcal,** by which the small communicates with the large intestine, is provided with a valve, **ileo-cœcal,** which is formed by a doubling of the mucous membrane and a strong band of muscular fibres contained between the layers. The mucous membrane of the large intestine contains no villi.

LIVER.

The **liver** (*plate* 6, *no.* 8), the largest gland in the body, is placed behind the diaphragm in the right hypochon-

driac, epigastric, and left hypochondriac regions. It is maintained in its position by five ligaments—a *falciform*, *broad two lateral*, *coronary*, and the *round* one; the first four are formed by reflections of the peritoneum, the last is the remnant of the umbilical vein of the fœtus. The liver presents for examination two surfaces, two borders, and two extremities. The anterior surface is convex and applied to the diaphragm; the posterior is concave, and is related to the stomach, duodenum, pancreas, colon, and right kidney, and is marked by a deep fissure, **portæ media,** which leads into the interior of the gland. The borders—superior and inferior; the former is thick and contains a deep notch for the passage of the œsophagus; the inferior border is thin and presents several notches in the centre. The extremities give attachment to the lateral ligaments.

Structure:—The liver is formed of three lobes—a *middle* and *two lateral*, right and left, which are enclosed in a covering of fibrous tissue. *Glisson's capsule*, which also gives an envelope to the structures that pass in and out of the gland. The substance of the gland is made up of a number of minute bodies, **hepatic cells,** which contain a nucleus, particles of bile, and oil globules; these form lobules which are about the size of a millet seed; each is surrounded by a plexus of blood vessels, **interlobular,** and contains in its centre another plexus formed by a small branch of the vena portæ, **intralobular**; these lobules are held together by a delicate envelope of connective tissue; from each lobule arises a small rootlet of the hepatic veins and a small transparent vessel which, by joining with others, ultimately form the hepatic duct. The interior of the gland is traversed by numerous channels, **portal canals,** which contain the branches of the vena portæ, hepatic artery, and hepatic duct. The hepatic duct is about half-an-inch in diameter as it leaves the organ, and is capable of great dilation; it is composed of two coats—an outer,

fibrous and partly muscular, and an internal, consisting of a mucous membrane; it leaves the liver by the portæ media, and opens into the first portion of the intestine, **duodenum**, alongside the pancreatic duct. The functions of the liver appear to be to rid the blood of hurtful matter, and elaborate matters of use in digestion and other nutritive acts. The liver of the horse has no gall bladder, whence the bile is supposed to be constantly flowing into the small intestines whilst digestion is going on. **Bile** is a fluid secretion of the liver, producing, in conjunction with the secretion from the pancreas, a decomposition of chyle in the intestines; in the horse it is stated to be only of one kind. It has been found by analysis to contain—

Water	904·4
Bilin, fat, and pigment	80·0
Mucus	03·0
Salts, chloride of sodium, phosphates, &c.	12·6
	1000·0

SPLEEN.

The **spleen** (*plate* 6, *no.* 5) is a ductless gland situated in the left hypochondriac region. It is related externally to the diaphragm; internally, to the greater or convex border of the stomach; anteriorly, to the liver; and posteriorly, to the left kidney and tail of pancreas. It is prismatic in form; and upon its inner aspect is situated a longitudinal furrow, **hilus**, which leads into numerous passages, **splenic canals.**

Structure.—It is composed of an external fibro-elastic tunic, **tunica albuginia**, which gives off numerous processes, **trabeculæ**, that form a reticulated framework in the interior; this tunic also gives sheaths to the blood-vessels as they pass into the gland. The proper substance of the spleen is contained in the meshes of its internal structure, and consists of a pulpy material similar in appearance to the red corpuscles of the blood, and of small white semi-

opaque bodies, **Malpighian corpuscles.** Each corpuscle is composed of a capsule containing a white gelatinous substance, surrounded by a capillary plexus of vessels; they are connected to the small arteries by processes formed by the sheaths of the vessels. The spleen is remarkable for its great vascularity and having a number of its arteries and veins communicating with each other without the intervention of capillaries. The use of the spleen is not yet positively determined; by its increase during digestion and in disease it has been regarded as a reservoir; a temporary one, it is true, but long enough for the blood to undergo some change most likely for its purification. It is said that the spleen receives albumen freely from the stomach during digestion.

PANCREAS.

The **pancreas** is situated transversely upon the superior aspect of the transverse colon. It consists of two parts—a body and a head; where these two meet exists a passage, **ring of the pancreas,** for the vena portæ. It is related superiorly to the crura of the diaphragm; inferiorly to the colon, and upon the left side to the spleen and left kidney; upon the right side to the liver, duodenum, and right kidney. It has two ducts which emerge from the head of the gland—the larger, **canal of Wirsung,** opens into the duodenum near the orifice of the biliary duct, and the other opens posteriorly to it. This gland is similar in structure to those of the salivary apparatus, and is frequently termed the *abdominal salivary gland.* The secretion is a colourless, viscid, or syrupy fluid, has a specific gravity of 1·010 and is always alkaline. Its salts resemble those of saliva.

THE PHYSIOLOGY OF DIGESTION.

Stimulated by the sensations of hunger and thirst, all

animals seek for and take into their stomachs such matters as their organs are fitted to the assimilation of, and to which they are instinctively directed by their senses of smell and taste, *prehension of food*. When a horse grazes he crops the grass with his incisive teeth. Oxen and sheep, wanting upper nippers, wrap a tuft of grass round with their tongue, and then apply the incisors, by which it is cut off. When a quantity of herbage is thus gained it is carried by the tongue and motor muscles to the upper part of the mouth to encounter the action of the grinders and undergo the process of mastication. During this process it becomes mixed with the salivary fluid secreted from the parotid, maxillary, and sub-lingual glands.

The vegetable mass having undergone complete mastication and insalivation, is, by the tongue, carried backwards and upwards into the pharynx, thence into the œsophagus, along which tube it is propelled backwards towards and into the stomach, *deglutition of food*. When the food is deposited within the stomach it is propelled forward by the muscular contractions of the organ in the direction of its great curvature, from left to right towards the pylorus, being so turned and contorted in its passage that every portion becomes macerated with its secretions, and, by the peculiar action of the gastric fluid, becomes reduced into a semi-pullaceous mass called *chyme*, after which it is hurried onward to have the chylous animalization completed within the intestines. The duodenum first receives the pulpy mass in a partial state of digestion, and this becoming mixed with the pancreatic and the biliary fluids, further changes take place in it, and chylification becomes more perfectly advanced. The mass is then propelled onward by the creeping muscular contractions of the intestinal tract, called its *peristaltic* motion. During its process the chyle is separated from the mass by the agency of the lacteals, which vessels, directing their course through the

mesentery, deposit their contents in the chylous receptacle, from which it is conveyed to the axillary vein and mingled with the blood. The small intestines empty their contents into the cæcum, thence into the colon and rectum. During its passage, until the termination of the latter at the anus, the food is supposed to be deprived of its nutritious principles, and undergoes what is termed defæcation. The fæces are retained in the rectum until the external and internal sphincters are overcome by the peristaltic action of the intestines, assisted by the diaphragm and abdominal muscles.

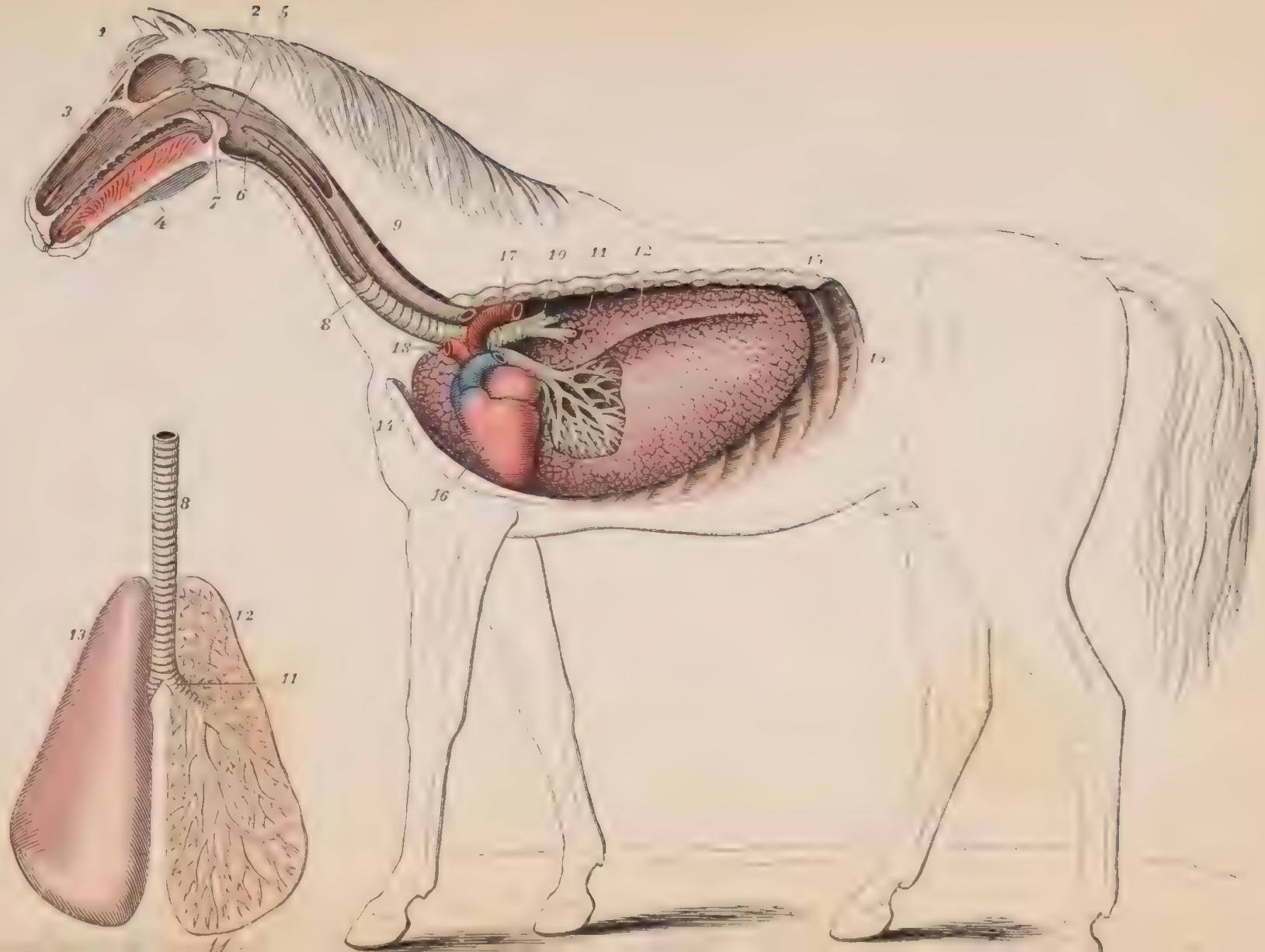

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PLATE 7.—RESPIRATORY APPARATUS.

1. Cranial cavity.
2. Guttural pouch.
3. Nasal cavity.
4. Tongue.
5. Pharyngeal cavity.
6. Cavity of larynx.
7. Epiglottis.
8. Trachea.
9. Œsophagus.
10. Section of left bronchus.
11. Ramifications of the right bronchus.
12. Right lung.
13. Left lung seen from above.
14. Sternum.
15. Ribs—fifteenth section of the left ribs.
16. Heart.
17. Posterior aorta.
18. Anterior aorta.

RESPIRATORY APPARATUS.

The **respiratory apparatus** (*plate* 7) consists of the *nostrils*, *pharynx*, *larynx*, *trachea*, *bronchial tubes*, and the *lungs*.

The **nostrils** are two in number, separated from each other by an osseo-cartilaginous partition, **septum nasi** (*plate* 7, *no.* 3). Each nostril presents two openings, *anterior and posterior nares;* the **anterior** presents at its supero-external aspect an infundibulum, **false nostril**, lined by a reflection of the skin; the **posterior nares** communicates with the pharyngeal cavity. The interior of each nostril is divided into three meati—a *superior*, between the nasal and upper turbinated bones; a *middle*, between the upper and lower turbinated bones; and an *inferior*, between the inferior surface of lower turbinated bone and the floor of the nasal cavity. The external nares are bounded by two curved cartilages, **alæ nasi**, placed back to back in the median line. The internal surface of the nose is lined by a mucous membrane, *Schneiderian*, which is soft, vascular, and contains numerous mucous glands; it is covered upon its greater portion by ciliated epithelium. Each nostril presents laterally two openings—one posteriorly, which communicates with the sinuses of the head, and the other anteriorly, which is the orifice of the nasal duct.

PHARYNX.

See digestive apparatus.

LARYNX.

The **larynx** (*plate* 7, *no.* 6) is a cartilaginous box com-

municating anteriorly with the pharynx, posteriorly with the trachea. It is formed of five cartilages, viz.:—the *cricoid*, *thyroid*, two *arytenoid*, and the *epiglottis* (*plate* 7, *no.* 7); these are connected together by means of muscles and ligaments. The **cricoid** cartilage is circular in outline, and, placed at the upper part of the trachea, it forms the posterior boundary of the larynx. The **thyroid** cartilage is made up of an antero-inferior and two lateral portions, which embrace the cricoid in all parts but its superior one. The **arytenoid** cartilages are two in number, quadrilateral in form, and situated above and in front of the cricoid. The **epiglottis** cartilage is triangular in shape, and situated at the anterior border of the thyroid cartilage, to which it is connected by its base, while the apex, which is free, looks upwards and forwards. The inner surface is lined by a mucous membrane which is very sensitive and covered by ciliated epithelium. This membrane near the centre of the organ is thrown into two folds on each side—a *superior* and an *inferior*. The former, **false vocal cords**, contain a small quantity of yellow elastic tissue; the latter, **true vocal cords**, contain a rounded bundle of yellow elastic tissue extending from the arytenoid cartilages downwards and forwards to the thyroid cartilage. Between the superior and inferior cords exists a small fossa, **ventricle of the larynx.** The ligaments which bind the cartilages together are composed of yellow elastic tissue. The uses of the larynx: This part answers two principal purposes. It is the organ by which air is received into the lungs; it is likewise the organ of the voice, hence, if the recurrent nerves, which furnish this part, be divided, the voice is entirely lost.

TRACHEA.

The **trachea, wind pipe** (*plate* 7, *no.* 8), is a cartilaginous tube extending from the larynx to the right side of the

posterior aorta, where it divides into the right and left bronchi. It is composed of about fifty cartilaginous rings which overlap each other superiorly, and are connected together by yellow elastic tissue. Internally it is lined by a mucous membrane covered by ciliated epithelium; the mucous membrane is connected to the rings by cellular tissue; the rings are also bound by a bundle of muscular fibres, **trachealis muscle.**

BRONCHIAL TUBES.

The **bronchi** are two in number—a right and left (*plate* 7, *nos.* 10, 11). The *right* is shorter, but the wider of the two; it enters the root of the right lung, where it divides dichotomously until its branches are reduced in size to about $\frac{1}{25}$ of an inch in diameter, where they terminate in the air cells of the lungs. The *left* bronchus crosses the posterior aorta and enters the root of the left lung, dividing in the same manner as upon the right side. The bronchial walls are chiefly formed of cartilage arranged in the form of plates, which overlap each other so as to constitute complete rings; these are enveloped in a layer of white fibrous and elastic tissue; upon the smallest tubes the cartilages disappear, their walls being formed of fibrous and muscular tissue. The mucous membrane is lined by ciliated epithelium, and possesses mucous glands which gradually disappear in the smallest bronchi.

LUNGS.

The **lungs** (*plate* 7, *nos.* 12, 13) are two in number, situated within the thorax on each side of the heart, each organ being isolated by a covering of serous membrane, **pleura.** Each lung is pyramidal in form and presents a base, a root, and an apex. The *base* is applied against the diaphragm, the *apex* against the first rib, and the *root* is the part by

which the lung becomes connected to the bronchus and the large blood-vessels which enter and leave the organ.

Structure.—It consists of a great number of small sacs which communicate with the terminal branches of the bronchial tubes; each sac has a lining membrane arranged in small ridges, leaving intervening spaces, **alveoli,** or **air cells**; these sacs are separated from each other by thin elastic walls, and are held together by elastic tissue. The air sacs are collected into small groups, **lobulettes,** which are again collected into larger groups, **lobules.** The lobules unite to form **lobes,** which being joined together constitute the lungs. The lobules and lobes are bound together by areolar and elastic tissue, in which ramify the blood-vessels, lympathics, and nerves of the organ. By this structure the lungs are fitted for the performance of their functions of respiration, which may be considered a process of excretion by which carbonic acid and superfluous water are discharged; it is also the means by which oxygen is introduced into the system, and the aeration of the blood completed.

PLEURA.

The serous membrane, **pleura,** which covers each lung, is formed of two layers—a parietal and visceral; the *parietal* lines the parieties of the thorax, and the *visceral* covers the external aspect of the lungs, the space between the two layers being termed the **cavity of the pleura.** The *parietal* portion is divided into three parts—the diaphragmatic, costal, and mediastinal. The *diaphragmatic* covers the diaphragm; the *costal* portion is reflected upon the inner surface of the ribs and their cartilages; while the *mediastinal* layers of the two pleuræ come in contact with each other in the median line, forming a partition between the right and left sides of the thorax. These layers, however, separate from each other at three points, constituting the

anterior, *middle*, and *posterior mediastina*. The **anterior** space contains the trachea (*plate* 7, *no.* 8), œsophagus (*plate* 7, *no.* 9), anterior aorta (*plate* 7, *no.* 18), and its branches, anterior vena cava, thoracic duct, cardiac plexus, and pneumogastric, recurrent, and phrenic nerves. The **middle mediastinum** contains the heart (*plate* 7, *no.* 16) and the root of its large blood-vessels, the bronchi, œsophagus, and pneumogastric and phrenic nerves. The **posterior mediastinum** contains the posterior aorta, vena azygos, thoracic duct, and pneumogastric nerves. The cavities of the two pleura communicate with each other by a number of reticulations at the postero-inferior part of the posterior mediastinum.

THYROID GLAND.

The **thyroid gland** is attached to the sides of the trachea below the larynx; it consists of two egg-shaped bodies connected to each other by a narrow slip, **isthmus.**

Structure.—It is composed of numerous closed vesicles containing a yellowish fluid; these vesicles are connected together into imperfect lobules by areolar tissue.

Its function is supposed to be to keep up an equable temperature about the larynx.

THYMUS GLAND.

The **thymus gland** is situated in front of the pericardium; it consists of two lobes which are elongated from before backwards; these are made up of lobules which enclose a central cavity, *reservoir*. Each of the lobules has a cavity and contains a pouch at its base, which leads into the reservoir, containing a creamy fluid. This gland is small in the adult, but large in the fœtus.

The uses of this gland are obscure. It is said to have been found almost entirely wasted in over driven lambs, and it diminishes and disappears in old horses.

URINARY APPARATUS.

The **urinary apparatus** consists of the *kidneys*, *ureters*, *bladder*, and *urethra*.

The **kidneys** (*plate* 6, *no.* 15) are two glands situated in the right and left sub-lumbar regions. The right kidney is placed about two inches more anteriorly than the left one; they are retained in their position by blood vessels and connective tissue. The relations of the organs are—superiorly, to the crura of the diaphragm and the psoas muscle; inferiorly, to peritoneum; anteriorly, on the right side to the suprarenal capsule and liver, on the left side to the suprarenal capsule, spleen, and pancreas; internally, on the right side to the posterior vena cava, and on the left to the posterior aorta. The right kidney is heart-shaped; the left is thinner and more elongated from before backwards. Each kidney presents two surfaces, two borders, and two extremities. The surfaces are smooth and slightly convex; the external border and extremities are rounded; the internal border presents a notch, **hilus**, near its centre. This notch leads into a space, **sinus**, which contains the enlarged portion of the ureter, **pelvis**, and the nerves and blood-vessels of the gland.

Structure.—The kidney consists of two portions—an external, **cortical**, and an internal, **medullary**; the former is dark in colour and is formed of a series of tortuous canals, **tubes of Ferrein**, which arise from little cellular bodies, **Malpighian corpuscles.** A corpuscle consists of a delicate capsule surrounding a convoluted branch of the renal artery, **rete mirabile**, which gives off a small vessel that leaves the cell and is distributed to the surrounding parts. The medullary portion joins the cortical by a zigzag

border, and is composed of a number of small tubes, **ducts of Bellini,** which open upon the summit of a ridge, **renal crest,** which projects into the ureter. The external surface of each kidney is covered by a fibrous membrane, **renal capsule,** which sends prolongations into the interior of the glands. The uriniferous tubes or canals above mentioned are lined by a delicate mucous membrane. They are united by an inter-tubular material of a granular consistence. The kidneys are connected to the surrounding parts by fat and connective tissue.

FUNCTIONS OF THE KIDNEYS.

The most complete example of an excretion is the urine as it is cast off from the body. The kidneys secrete this fluid from the blood. Both its quantity and its quality are very variable, and very much under the influence of circumstances. Its quantity may be increased at pleasure by giving an inordinate quantity of water after extreme thirst; it is also increased by the nature of the food, as a green meat, mow-burnt hay. Many substances have an effect on its quality likewise; a dry meat, as oats, beans, and barley, frequently produce a scanty evacuation; but it is, under these circumstances, invariably of a higher colour, and possesses a more acrid smell. Urine in colour is yellow, of a lighter or deeper tint; but sometimes it is transparent and at others turbid in the extreme; in flavour it is more or less saline; its odour is peculiar, always pungent, sometimes offensively so, at others rather fragrant; but its compounded qualities subject it to early decomposition and separation. Its specific gravity is somewhat greater than that of water.

It is stated by Professor Brand that the urine of the horse contains: urea, 0·7; urobenzoate of soda, 2·4; carbonate of soda, 0·9; chloride of potassium, 0·9; carbonate

of lime, 0·2 to 1·1 ; water, 91·0 ; CHEVREUN found sulphate of lime.

The urine of the cow contains a large relative proportion of urea and urobenzoic acid, and, exposed to air, deposits small crystals of carbonate of lime and carbonate of magnesia.

The substances generally found in urine are the following :—Water, carbonic acid, phosphoric acid or superphosphate of lime, uric acid or superurate of ammonia, phosphate of lime, phosphate of ammonia, phosphate of soda, phosphate of magnesia, common salt, sulphate of soda, albumenurea.

The secretion of the kidneys carries off several substances from the blood, which would be injurious if retained, and are, for the most part, abundant in nitrogen.

The **ureters** are two tubes arising by a trumpet-shaped mouth, **pelvis**, from the sinus of the kidney in which they are connected to the renal crest and continuous with the renal capsule. Each tube proceeds backwards and downwards above the peritoneum, opening into the supro-lateral aspect of the bladder, about two inches from the orifice of the urethra. The ureters run for some distance between the muscular and mucous coats of the bladder before opening upon its inner surface. Their walls are composed of two coats—an external, which is fibrous, containing two layers of unstriped muscular tissue, and an internal mucous membrane.

The **bladder** (*plate* 6, *no.* 16) is the urinary reservoir, situated in the pelvic cavity, resting upon the superior aspect of the os pubis and ischium. It is related superiorly to the rectum in the male, and to the vagina and uterus in the female ; inferiorly, to the floor of the pelvis ; anteriorly, to the small intestine and peritoneum ; posteriorly, to the urethra, and on each side to the pelvic walls. The bladder is ovoid in form, and presents a *base*, *body*, and

a *fundus*. The **base** looks backwards, and is continuous by its neck with the urethra; the **fundus** looks forwards, and is connected to the remnant of the urachus and a fold of the peritoneum. It is retained in its position by ten ligaments, five true and five false. The true ligaments consist of two lateral and two inferior, which are formed by the fascia, and the remnant of the urachus connecting it to the abdominal walls. The false ligaments are formed by reflections of the peritoneum, and comprise the recto-vesicle in the male or vesico-vaginal in the female, two lateral, and an anterior or suspensory.

Structure.—The bladder is formed of three coats—an external *peritoneal*, middle *muscular*, and internal *mucous membrane*. The **peritoneal** coat is confined to its anterior two-thirds; the **muscular** is formed of several layers of fibres which have an oblique, longitudinal, and circular arrangement; the **mucous** coat is pale, glandular, and rugose, except a small space of a triangular form, **trigonum vesicæ**, bounded posteriorly by the urethra, and anteriorly by the two openings of the ureters. At the apex of this space the mucous membrane forms a small reflection, **uvula vesicæ**, which partly covers the urethral opening. The neck of the bladder is composed of yellow elastic tissue. To this the muscular fibres are attached. When the organ becomes distended with urine, the muscular fibres are excited into action. The oblique diminish its diameter, while the longitudinal muscle attached to the neck overcomes the opposition at the convex end of the bladder and dilates the opening. The urine thus becomes released, and, forced out by the energetic contraction of the muscles, passes into the urethra and thence is discharged upon the ground.

The **urethra** (*plate* 6, *no.* 17) is common in the male to the urinary and generative apparatuses; in the female it is exclusively a urinary organ. It consists in the female of a

short tube about one inch in diameter, which arises from the neck of the bladder and opens into the vestibule about four inches from the external aspect of the vulva. This opening, **meatus urinarius**, is protected by a fold of mucous membrane, **valve**, which opens backwards.

Structure.—it is formed of two coats—an external fibro-muscular, which is intimately connected to the vagina by a thick layer of areolar tissue, and an internal mucous membrane. (Urethra of male, see generative organs.)

SUPRARENAL CAPSULES.

The **suprarenal capsules** are two small elongated bodies situated between the anterior extremities of the kidneys and the crura of the diaphragm; they are attached to the surrounding parts by areolar tissue. They consist of two portions, a *cortical* and a *medullary*; the **cortical** forms the larger part of the gland, and is composed of columnar masses and tubules containing oil globules of a yellowish colour; the **medullary** is in the centre, of a brown colour, and is composed of granular matter. They contain numerous blood-vessels and nerves, and are largest in the **fœtal state.**

GENERATIVE SYSTEM.

MALE GENERATIVE ORGANS.

The **male generative organs** consist of the *testicles*, *spermatic duct*, *vesiculæ seminalis*, *prostate gland*, *Cowper's glands*, and the *urethra*. The **testicles** are two ovoid bodies situated one on each side of the penis; each testicle is enclosed and protected by several layers of tissue, which are arranged from without inwards in the following manner:—the *skin* and *dartos* which form the **scrotum**, the *cremaster*, *fibrous tunic*, and the *tunica vaginalis*. The **skin** forms a common pouch for both testicles; it is of a dark colour, thin, and covered by delicate hairs; upon its median part exists a groove, **raphæ**, which is directed from before backwards. The **dartos** is brown in colour, and is composed of contractile fibrous tissue; it forms two distinct pouches, separated from each other by a median partition. The **cremaster** is a muscular band arising superiorly from the transverse fascia and oblique muscle of the abdomen, becoming inserted upon the external aspect of the cord. The **fibrous tunic** forms a complete envelope to the tunica vaginalis; it is a continuation of the fascia transversales of the abdomen. The **tunica vaginalis** is derived from the peritoneum, and consists of two layers—a *parietal*, related externally to the fibrous tunic, and a *visceral*, which covers the outer surface of the testicle and spermatic cord.

The **testicles** are two in number, having an ovoid form and slightly compressed from side to side; they are situated in the pouch above described and suspended by the spermatic cord, which connects them by its superior border to the epididymus.

Structure.—Each testicle is composed of a number of lobuli surrounded by a fibrous and a vascular tunic. The fibrous, **tunica albuginea,** is a strong white membrane, which sends from its internal surface numerous processes, **septa,** into the interior of the gland; at the antero-superior part of the testicle this tunic dips into its structure, forming a partial septum, **mediastinum testis.** The vascular tunic or **pia mater testis** consists of a plexus of blood-vessels held together by areolar tissue; it lines the inner surface of the tunica albuginea. Each lobule of the testicle is composed of a number of convoluted tubes, **tubuli seminifera**; these tubuli become straight and less numerous as they approach the mediastinum testis, in which they form an irregular plexus, **rete testis**; from the rete testis arise a number of tubes, **vasa efferentia,** which open into the globus major of the *epididymus.* The testicles are located in the sub-lumbar region during fœtal life, but descend into the scrotum a short time previous to birth; they are directed in their descent to the scrotum by a fibrous cord, **gubernaculum testis**; at times they are retained in the inguinal canal for several months.

The **epididymus** is a flexous canal, situated upon the supra-external part of the testicle. It is divided into three parts—a head, **globus major,** a tail, **globus minor,** and a body. The *head* is situated anteriorly, and contains the openings of the vasa efferentia. The *tail* is continuous with the spermatic duct.

The **spermatic duct, vas deferens,** arises from the tail of the epididymus, and passes through the inguinal canal to the abdomen, where it is directed backwards to the pelvis, and there receives the duct of the vesiculæ seminales, **ejactulatory canals**; after which it opens into the urethra below the prostate gland. It is composed of two coats—externally, dense muscular and fibrous tissue, and internally, **mucous membrane.**

The **spermatic cord** consists of two arteries, a nerve, the spermatic duct, and its coverings.

The **vesiculæ seminales** are two ovoid pouches situated above the bladder, each pouch ending posteriorly in a short canal which joins the spermatic duct. They are composed of three coats—an external, *serous;* middle, *muscular;* and an internal, *mucous membrane.*

The **prostate gland** is situated between the neck of the bladder and the rectum. It is formed of two lateral lobes enclosed in a capsule. The interior consists of communicating cells which open into the urethra by numerous small ducts.

Cowper's glands are two in number, each being placed upon the side of the urethra close to the ischiatic arch, and opening into it by small ducts. Its structure is the same as the prostate gland.

The **urethra** is a long tube, divided into three portions. The *prostatic* portion is the widest and situated beneath the prostate gland; it has a slight eminence upon its upper aspect, and upon each side of it are the openings of the prostatic ducts. At its anterior extremity is found a small fossa, and upon each side of it, anteriorly, the openings of the ejactulatory ducts. The *membranous* portion extends from the prostate gland to the ischiatic arch. The *spongy* portion is the longest of the three divisions, and is surrounded by the corpus spongiosum; at its origin it presents a dilation, **bulb**; its anterior extremity presents a circular opening, **meatus urinarius**; and posteriorly to it a depression, **fossa navicularis.** It is composed of three coats—an *erectile, muscular*, and *mucous membrane*, which contain follicles, **glands of Littre.**

The **penis** is the organ of copulation and is about twenty inches in length. It is composed of two erectile bodies called the *corpus spongiosum* and *corpus cavernosum.* The **corpus spongiosum** arises at the bulb of the urethra, and

terminates in the glans penis at the anterior extremity of the organ. It is situated upon the inferior aspect of the urethra, which it encloses. The **corpus cavernosum** forms the greater portion of the penis; it is divided into two lateral halves by an imperfect partition, **septum pectiniforme**; it arises from the tuberosities of the ischium, and occupies the dorsum surface of the organ. Both portions are covered by a fibrous envelope, which encloses erectile tissue, and consists of an intricate venous plexus lodged in inter-spaces formed by processes from the fibrous covering; the arteries communicate with the veins through the medium of sinuses. The penis has two ligaments, **retractor,** which arise from the sacrum and are inserted upon the **inferior part of the urethra.**

The **sheath** is formed by a reflection of the skin which encloses the penis (except during erection). Its internal surface resembles a mucous membrane, and contains numerous glands, **glandulæ Tysoni.** It contains between its two layers an expansion of yellow elastic tissue, which forms the suspensory ligament of the penis.

FEMALE GENERATIVE ORGANS.

The **female generative organs** consist of the *ovaries*, *fallopian tubes*, *uterus*, *vagina*, and *vulva*.

The **ovaries** are two egg-shaped bodies situated in the sub-lumbar region, where they are attached to the fallopian tubes and surrounded by peritoneum.

Structure.—Beneath the peritoneum is a layer of white fibrous tissue, **tunica albuginea,** and from its inner surface numerous prolongations, **septa,** pass into the glands; in the spaces between the septa exists a reddish yellow coloured substance, **stroma,** in which are lodged small bodies, **Graafian vesicles**; each vesicle consists of an external vascular tunic and an internal one, **ovi capsule,** which is

lined by a granular substance, **membrana granulosa,** and within this membrane is a yellow fluid in which floats the ovum. The ovum is a small spherical body covered by the zona pellucida or vitelline membrane; within it is the yelk, consisting of granules, in which is found the germinal vesicle, and upon it a yellow spot, **germinal spot.** The ovaries are very large during fœtal life.

The **fallopian tubes, oviducts,** are two small canals arising from the ovaries and terminating by a very small opening upon the uterine horns. The ovarian extremity opens into the peritoneal sac, and is surrounded by processes, **fimbræ.** They are composed of three coats—an external, *serous;* middle, *muscular;* and an internal, *mucous membrane.*

The **uterus** is a musculo-membranous sac, lodged partly in the pelvic and partly in the abdominal cavities. It is divided into body, horns, and neck. The body is cylindrical in form, and situated between the bladder and rectum; posteriorly it is continuous with the neck, and anteriorly with the horns. The horns, **cornua,** consist of a right and a left, which arise from the antero-lateral parts of its body, and diverge from each other, curving upwards and forwards in the abdominal cavity, where they become connected to the fallopian tubes. The cervix or neck is short and constricted, and protrudes backwards into the vagina. This organ contains three openings—two anteriorly and one posteriorly; the latter, **os uteri,** is bounded by two prominent lips, and has its mucous membrane arranged in numerous folds which give it an arborescent appearance, **arbor vitæ uterinus.** The uterus is retained in its position by six ligaments, viz.:—two broad, suspending the horns in the abdomen; two lateral, connecting the body to the sides of the pelvis; the vesico-uterine attaching it to the bladder; and the recto-uterine attaching it to the rectum.

Structure.—It is composed of three coats—an external,

peritoneal, which forms the ligaments above mentioned; the middle, *muscular*, formed of two layers, external longitudinal and internal circular; and an internal, *mucous membrane;* at the neck the membrane is rugose, and contains numerous glands. During gestation the uterus is very much enlarged, and its middle and inner coats are much thickened.

The **vagina** is a musculo-membranous tube, extending from the neck of the uterus to the vulva; and is related to the rectum superiorly, and to the bladder inferiorly. It is composed of two coats —an external of *muscular*, *areolar*, and *erectile tissue;* and an internal of *mucous membrane*, which is continuous with that of the uterus.

The **vulva** is the external organ of generation. Under this term are included the *rima magnus*, *labia*, *nymphæ*, *hymen*, and *clitoris*. The **rima** is the vertical opening of the genito-urinary organs; it is bounded laterally by the labia, and superiorly and inferiorly by the *commissures*. The **labia** form the two rounded prominences seen externally, and are composed chiefly of fatty and fibrous tissue, covered externally by the skin, internally by mucous membrane. The **commissures** are two, a superior and inferior; within the superior commissure is situated a slight fold of mucous membrane, **fourchette**, and in the space between it and the commissure is found the navicular fossa.

The **clitoris** is situated within the inferior commissure. It consists of a small elongated body about two inches in length when erected, formed of erectile tissue. It is composed of two parts—the corpora cavernosa, which diverge and become attached by their crura to the rami of the ischium; its summit presents a bulbous enlargement similar to the glans penis, and is surrounded by a fold of mucous membrane similar to the prepuce of the male.

The **nymphæ** are two small folds of mucous membrane

prolonged from the clitoris to the floor of the vulva. Between them exists a smooth surface, **vestibule**, which contains the meatus urinarius.

The **hymen** is situated anteriorly to the meatus urinarius, and consists of a delicate fold of mucous membrane which is stretched across the posterior orifice of the vagina. It is destroyed during the first act of coition, leaving only a few rounded eminences, **carunculæ myrtiformes.**

Structure.—The vulva in all parts is very vascular, and contains a considerable amount of erectile tissue and fat. The mucous membrane contains numerous sebaceous and mucous glands which secrete an odorous substance.

Upon each side of the vaginal opening, beneath the superficial fascia, are situated two glandular bodies, **glands of Bartholin,** having a long duct which opens upon the inner side of the nymphæ.

MAMMARY GLAND.

The **mammæ** are situated between the thighs, and are two hemispherical bodies separated by a median groove, and presenting on their central parts a conical prolongation, **teat.** They are covered externally by the skin, which is of a dark colour, soft, and provided with numerous sebaceous glands. The teat is dark in colour and rounded, containing at its base rugæ; and at its inferior part it presents two or three orifices which are the apertures of the lactiferous ducts.

Structure.—Situated beneath the skin is a yellow elastic capsule which forms an envelope for each gland. The gland tissue is lobulated and of a yellow colour; each lobule is composed of a cluster of vesicles which form the origin of numerous ducts, **galactophorus,** that converge towards the base of the teat, where they open into cavities, **galactophorous sinuses**; from these arise the ducts that

open upon the apex of the teat. The vesicles and ducts are bound together by blood-vessels, fat, and areolar and erectile tissue.

ORGANS OF SENSE.

The organs of the senses are five in number, viz. :—those of *sight*, *smell*, *taste*, *hearing*, and *touch*.

THE EYE.

The **eyeball** is situated within the orbital cavity, surrounded by a number of muscles, and protected in front by several appendages. It is spherical and somewhat flattened from before backwards, and is composed of three coats and three humours. The coats are—the *sclerotic* and *cornea*, *choroid* and *iris*, and the *retina*. The humours are the *aqueous*, *crystalline lens* and its *capsule*, and the *vitreous*.

The **sclerotic** is the thickest of the three, and forms the external tunic of the eyeball. It is composed of white fibrous tissue, and is separated internally from the choroid by a thin layer of connective tissue ; where this coat gives passage to the optic nerve it presents a number of small foramina, **laminæ cribrosæ.**

The **cornea** is the anterior transparent part of the eyeball; it is oval in a transverse direction, and its circumference is covered by the sclerotic coat. It is composed of layers, a fibrous, **cornea proper**, and anterior and posterior elastic layers. The cornea proper is composed of numerous laminæ.

The **choroid** coat is a thin vascular dark coloured membrane perforated posteriorly by the optic nerve, terminating anteriorly in a number of folds, **ciliary processes.** It is formed of three layers—an external, middle, and internal. The *external layer*, **venæ vorticosæ,** consists of arteries, veins, and dark pigment cells ; the

middle layer, **tunica Ruyschiana,** consists of a delicate capillary plexus formed by the short ciliary vessels; the *internal layer*, **tunica nigra,** is a delicate membrane consisting of hexagonal pigmentary nucleated cells. At the posterior part of this layer it presents a glistening green appearance, **tapetum lucidum.** The ciliary processes are formed by a plaiting inwards of the middle and internal layers of the choroid; they are arranged behind the iris like the petals of a flower.

The **iris** is a thin oval-shaped contractile curtain suspended in the aqueous humour behind the cornea, and presenting in its centre a transverse oval aperture, **pupil.** It is composed of fibrous tissue, muscular fibres, blood-vessels, and pigmentary cells. The muscular fibres form two muscles—one surrounds the pupil, **sphincter pupillaris,** and the other radiates from the pupil to its circumference, **dilator pupillaris.** Around its circumference is a ligament, **ciliary,** which connects the choroid and iris to the sclerotic and cornea. The anterior and posterior surfaces of the iris are covered by pigment which forms small globular bodies, **corpora nigra,** that hang from the superior margin of the pupil. The ciliary muscle arises from the point where the cornea and sclerotic coats join, and is inserted upon the choroid coat.

The **retina** is formed by the expansion of the optic nerve. It consists of three layers—an external **membrana Jacobi,** which is composed of columnar rods and cone-shaped bodies, with their apex towards the choroid and base resting upon the next layer; the middle is formed of oval and nucleated corpuscles; the internal layer consists of the terminal fibres of the optic nerve, which is lined by a transparent membrane.

The **aqueous humour** is situated in the anterior and posterior chambers of the eyeball. The anterior chamber is the larger, and is bounded by the cornea anteriorly and

the iris posteriorly. The posterior is bounded anteriorly by the posterior surface of the iris, and posteriorly by the capsule of the crystalline lens. These chambers communicate with each other through the pupil, but in the fœtus they are separated by the membrana pupillaris. This humour is composed of water and chloride of sodium.

The **vitreous humour** is situated within the retina; it is a jelly-like substance enclosed in a transparent membrane, **hyaloid**; it is concave anteriorly for the reception of the crystalline lens.

The **crystalline lens** and its **capsule** are placed behind the pupil and surrounded by the ciliary processes of the choroid. It is circular in outline and bi-convex, the posterior convexity being greater than the anterior. The lens is maintained in its position by the suspensory ligament, which consists of a thin transparent membrane attached to its circumference, and by plaits to the ciliary processes; between the suspensory ligament and the hyaloid membrane exists a space, **canal of Petit.** The **capsule** is a transparent elastic membrane, thickest anteriorly, and lined on its internal surface by a layer of cells which break down after death and form the liquor Morgagni. The lens consists of three segments composed of laminæ, which become harder in consistency as they approach the centre.

APPENDAGES OF THE EYE.

The **appendages of the eye, tutumina oculi,** consist of the *eyelids*, *eyelashes*, *conjunctiva*, *membrana nictitans*, and the *lachrymal apparatus.*

The **eyelids** are two, a superior and an inferior; the former is the larger and more mobile of the two. They are composed of the skin, areolar and muscular tissues, the tarsal cartilages, two, fibrous membrane, meibomian glands, and conjunctiva. The tarsal cartilages are semi-lunar in

form, attached to the orbit by fibrous tissue, **tarsal ligament.** The meibomian glands are situated between the tarsal cartilages and the conjunctiva ; they consist of straight follicles ; their orifices are small, and open upon the free margin of each lid. The conjunctiva is a mucous membrane consisting of three portions; the palpebral portion is very vascular and contains the openings of the lachrymal ducts and meibomian follicles ; the sclerotic portion is opaque ; the corneal portion is transparent. The external angle of the eyelids is very acute, and is called the external canthus ; the internal canthus is rounded.

The **eyelashes, cilia,** consist of long hairs attached to the free border of the eyelids.

The **membrana nictitans** is situated at the inner canthus of the eye, and consists of a triangular piece of cartilage enclosed in a fold of the conjunctiva, which is adapted to the form of the eyeball ; its apex is directed inwards, and its base outwards. The portion of the conjunctiva that enters into its formation is loose and contains a number of glands, **Henderian glandules.**

The **lachrymal apparatus** consists of the *lachrymal gland, ducts, caruncula lachrymalis, lachrymal sac, lachrymal canals,* and *nasal duct.* The **lachrymal gland** is situated at the outer canthus of the eye, beneath the supra-orbital process of the frontal bone ; its structure resembles the salivary glands ; its **ducts** are seven in number, which open upon the inner surface of the upper eyelid. The **caruncula lachrymalis** is a dark coloured eminence situated at the inner canthus of the eye ; it is formed of a number of follicles which secrete mucus.

The **lachrymal canals** arise from minute orifices, **puncta lachrymalia,** seen near the inner canthus ; the superior canal is the longer, and opens into the lachrymal sac ; the inferior canal also opens into the same sac. The **lachrymal**

sac is a small membranous bag lodged in the fossa of the lachrymal bone; it receives the tears from the lachrymal canals, and passes them to the nasal duct. The **nasal duct** is a membranous canal, which arises from the lachrymal sac, and terminates at the inferior meatus of the nose, about an inch from its outer margin. All the canals above mentioned are lined by mucous membrane, which is continuous with the conjunctiva and mucous membrane of the nose.

THE NOSE.

The **nose** is the special organ of the sense of smell. (For its boundaries see respiratory organs.) Its mucous membrane, **Schneiderian,** is studded with numerous papillæ on its posterior third, which receive the terminal branches of the first pair of cranial or olfactory nerves; the epithelium, which covers this portion of the mucous membrane, is destitute of cilia.

THE TONGUE.

The **tongue** (see digestive organs) is the organ of taste; it receives three pairs of nerves, viz.—the gustatory branch of the fifth, for taste; the ninth or lingual, for motion; and the glosso-pharyngeal, a branch from the eighth pair, the function of which is doubtful.

THE EAR.

The **ear** is the organ of hearing; it consists of three portions — the *internal*, *middle* and *external* ear. The **internal ear, labyrinth,** is formed in the petrous temporal bone; it is composed of three parts—the *vestibule*, *semicircular canals*, and *cochlea*. The **vestibule** is an oval cavity presenting upon its inner wall foramina for the

passage of the filaments of the auditory nerve; upon its outer aspect the fenestra ovalis, by which it communicates with the middle ear; anteriorly, another aperture which leads into the cochlea; and posteriorly, the five openings of the semi-circular canals. The **semi-circular canals** are three, viz.—a *superior*, *posterior*, and *external*; they communicate with the vestibule by five openings, and each presents a dilation, **ampulla**; the posterior and external canals coalesce and form a common orifice. The **cochlea** is a conical spiral-shaped organ twisted round a central axis, **modiolus**; it is partially divided into two parts, **scalæ**—an inferior and superior—by means of a central osseous lamina, **lamina spiralis.** The inferior part, **scala vestibuli,** opens into the vestibule; the superior, **scala tympani,** opens into the tympanic cavity; they communicate with each other at the apex of the cochlea by an opening. The internal surface of the osseous labyrinth is lined by a fibro-serous membrane, and also contains an exact membranous counterpart, **membranous labyrinth**; between the osseous and membranous labyrinths is a space which contains a fluid, **perilymph.** The vestibular portion of the membranous labyrinth is divided into two parts, the utricle and saccule, which contain a fluid, **endolymph,** and several minute calcareous concretions. The filaments of the auditory nerve are chiefly distributed to the cochlea and vestibular portions of the membranous labyrinth.

The **middle ear, tympanum,** is also formed in the petrous temporal bone; it presents two surfaces and a circumference. The outer surface is bounded by the membrana tympani; the internal surface presents two openings—the *fenestra ovalis* leading into the vestibule, and the *fenestra rotunda* leading into the cochlea; these openings are separated by a slight eminence called the promontory. The **membrana tympani** separates the middle from the external ear, and is attached round the tympanic orifice of

the external auditory meatus; it is convex internally and concave externally; it consists of a central layer of white fibrous tissue covered externally by the skin and internally by mucous membrane. The circumference of the tympanum is surrounded by a number of cells, **mastoid,** hollowed out in the structure of the bone. This cavity contains three bones, viz.—*malleus*, *incus*, and *stapes;* the first resembles a mallet, the second an anvil, and the third a stirrup iron; these bones are connected to each other by muscles and ligaments. The middle ear is lined by a mucous membrane which communicates with the pharynx by the Eustachian tube. The Eustachian tube is formed of fibro-cartilage, and at its pharyngeal opening it forms an infundibulum, **guttural pouch,** which is also lined by mucous membrane.

The **external ear** is composed of three cartilages—the *conchal*, *annular*, and *scutiform*. The **conchal cartilage** is trumpet-shaped; it is attached to the annular cartilage, and by fibrous tissue to the surrounding parts. The **annular cartilage** is a small ring connected to the external auditory process and conchal cartilage; both cartilages are covered and lined by the skin, which contains glands internally, **glandulæ ceruminosæ.** The **scutiform cartilage** is irregular in form and flattened, situated upon the temporal muscles; it is connected to the other cartilages of the ear by muscles and fibrous tissue.

THE SKIN.

The **skin** is composed of two layers — the *epidermis*, *cuticle*, which is the external, and the *dermis*, *true skin*, or deep layer. The **cuticle** consists of two layers—an external, which is composed of hard flattened cells, and a deep, **rete mucosum,** which is made up of soft cells containing pigmentary matter. The outer surface of the skin

presents numerous eminences and apertures which correspond to the papillæ and glands of the skin. The **true skin** is also composed of two layers—a superficial, **papillary,** and a deep, **corium** ; the former presents elevations, **papillæ,** which are conical in form, vascular, and contain the organs of touch ; the deep layer, **corium,** is composed of areolar tissue, blood-vessels, lymphatics, nerves, glands, and hair follicles.

APPENDAGES OF THE SKIN.

The **appendages of the skin** consist of the *sudoriferous* and *sebaceous glands, hair, ergots,* and *horse chestnuts.*

The **sudoriferous glands** are very numerous ; each is formed of a long tube coiled upon itself and surrounded by a plexus of capillaries ; they are located in the subcutaneous tissue ; the ducts open upon the free surface of the skin.

The **sebaceous glands** are small sacs lodged in the meshes of the corium, and open by a short duct into the hair follicles, and at times upon the free surface of the skin.

The **hair** covers the entire surface of the skin ; each consists of a root, **bulb,** which is implanted in the follicle, and of a shaft projecting more or less beyond the skin. The hair follicle is formed by an involution of the skin, and attached to each is a small bundle of unstriped muscular tissue, which causes the elevation of the hair. The bulb of the hair surrounds a papilla which consists of soft cells. The shaft of the hair consists of two portions, a cortical and a medullary ; the latter contains the colouring matter of the hair ; the external surface of the hair is imbricated.

The **ergots** are horny-like protuberances, situated at the base of the sesamoid bones of the fetlock.

The **horse chestnuts** are similar to ergots in appearance,

and are situated upon the inner aspect of the arm and below the hock joint.

THE HOOF.

The **hoof** is also an appendage of the skin, and consists of three parts—*wall*, *sole*, and *frog*. The **wall** is the largest portion of the hoof; it is conventionally divided into toe, quarters, and heels; the latter are inflected inwards upon the frog and are termed the **bars**. The outer surface of the hoof is convex from side to side; the inner surface presents numerous horny laminæ, about 600 in number; its superior border presents a groove which contains the coronary band; on the outer surface of the wall, corresponding to the cutidural groove, exists a band, **coronary frog-band**, of horny material which forms a circle that becomes continuous with the frog; its inferior border is attached to the circumference of the sole. The **sole** is concave inferiorly, and fixed to the wall and frog, and its superior surface is adapted to the structures above it. The **frog** is triangular in form, situated between the inflections of the wall; it presents a superior, inferior, and two lateral surfaces, a base and an apex; its *superior* surface is adapted and attached to the sensitive frog; the *inferior* surface presents a cleft posteriorly; its *lateral* surfaces are connected to the bars; its *base* is formed of two rounded portions, separated by the cleft; its *apex* is adherent to the sole.

Structure.—The various parts of the hoof are composed of tubular horny fibres held together by an inter-tubular material composed of cells and granules. Their constituents vary in number in different parts, which variations explain why some portions (as the wall) should be hard and comparatively unyielding, while the frog should be soft and highly elastic. The fibres are developed from the papillæ resting upon the secreting covering of the foot, while the

agglutinating material is formed from the spaces between them, and from the laminæ upon the antero-lateral parts of the os pedis, and also from the sensitive sole.

Within the **hoof** are situated the os pedis, navicular and inferior part of the os coronæ, ligaments, tendons, blood-vessels, lymphatics, and the structures from which the hoof is developed. All but the latter have been already described.

The *structures* from which the hoof is developed consist of a thick layer of fibro-vascular tissue, covering the exterior of the os pedis and its prolongations, *lateral cartilages.*

The **lateral cartilages** are two flattened plates situated upon each side of the coffin bone, to which they are attached, and beneath them are two inferior cartilages.

The **plantar cushion** is placed between the lateral cartilages, flexor tendons, and the horny substance; its inferior surface presents an eminence in the centre, **sensitive frog,** the exact counterpart of the horny frog. At its posterior part it is divided by a depression into two bulbs which correspond to the heels of the hoof. It is composed of white and yellow elastic tissue and blood-vessels.

The **vascular** and **sensitive** membrane, lying adjacent to the hoof, is divided into two portions—one covering the plantar cushion, from which are developed the sole, frog, and bars, and is covered by numerous villi. The other, the laminated portion, **sensitive** or **sensible laminæ,** covers the front and side of the os pedis, part of the lateral cartilages, and bulbs of the plantar cushion. The laminæ extend parallel to each other from below the inferior border of the cutidura to the plantar border of the os pedis; they number about six hundred, and are implanted into the spaces between the horny laminæ. This vascular membrane is connected to the parts it covers by a reticulated structure, in which are embedded the blood-vessels, nerves, and lymphatics.

The **cutidural** or **coronary band** is lodged in the groove at the superior border of the hoof; its superior border blends with the skin; its outer surface presents numerous papillæ, which are inserted into the pores of the cutidural groove.

The **coronary band**, like the laminated and other portions of the vascular tunic of the foot, is attached to the subjacent parts by fibrous tissue.

GLOSSARY.

Abdomen. The largest cavity in the body; the belly.

Abducent (*ab*, from; *duco*, to lead). Applied to muscles by which the members or limbs are drawn from the mesial line.

Abduction. That movement by which one part is separated from another.

Abnormal. Contrary to the natural condition.

Abomasum (*ab*, from; *omasum*, the paunch). The fourth stomach of the ruminantia.

Absorbent. Sucking up or absorbing; applied to the lacteal and lympathic vessels.

Accessories. Applied to the muscular appendages that assist the action of larger muscles.

Adducens. Bringing together.

Adductor. Applied to muscles that perform adduction.

Adipose. Of the nature of fat.

Adipose Membrane, **Adipose Tissue** } Cellular tissue with fat collected in its cells.

Ala, a wing, applied to parts from their resemblance, as the alæ nasi.

Alimentary. Pertaining to aliment; nourishing.

Alimentary Canal. The whole passage from the mouth to the anus.

Allantoid Membrane. A membrane communicating with the bladder by the urachus, and containing the fœtal urine.

Alveolar. Belonging to the alveoli or sockets of the teeth.

Alvine. Belonging to the belly, stomach, or intestines.

Amnion. The most internal membrane, containing the waters which surround the fœtus in utero.

Antrum. A cavity.

Anus. The extremity of the rectum; the fundiment.

Aorta. The arterial trunk arising from the left ventricle of the heart.

Appendix. A part of or addition to a thing.

Arachnoid. Resembling a spider's web. The second or middle membrane of the brain.

Arytenoid Cartilages. Two cartilaginous bodies of the larynx, which, in their natural position, resemble the mouth of a pitcher.

Basilar. A term applied to the base of the skull.

Biceps. Having two heads.

Bronchi. The first two branches of the trachea or windpipe.

Calamus Scriptorius. A narrow fissure on the back and in the median line of the pons varolii.

Cancelli. Minute divisions in the reticulated structure of bones.

Canthus. The angle formed by the junction of the eyelids.

Capillary. A term applied to the minute ramification of the arteries.

Capsular Ligaments. A ligamentous bag surrounding every moveable articulation, and containing synovia.

Cauda Equina. The termination of the spinal cord, which, giving off a large number of nerves, has a resemblance to a horse's tail.

Cell. A body enclosing various kinds of contents, or consisting of one or more internal vesicles, then called nuclei, containing granules or nucleoli; a corpuscle.

Chordæ Tendineæ. Attachments connecting the carneæ columnæ of the ventricles to the auricular valves of the heart.

Chordæ Vocales. The thyro-arytenoid ligaments of the larynx.

Chyle. The milk-like liquor from which the blood is formed, occupying the lacteal vessels and the thoracic duct.

Chylification. The process by which the chyle is separated from the chyme.

Chyme. The pulpy mass formed by the food in its first great change in the digestive process.

Cœliac Plexus. A name for the solar plexus.

Compressor.—Applied to a muscle which presses upon any part.

Concha. The hollow portion of the external ear.

Condyle. The round eminence at the end of a bone in a joint.

Corona. Applied to acute eminences of bone, or any objects or parts bearing resemblance to a crown.

Corpora. Bodies or substances; applied to several objects.

Cotyloid. Resembling a drinking cup.

Crassamentum. A soft, almost solid mass, of a deep brownish red, formed by venous blood soon after it has been extracted; a clot.

Crista Galli. A process on the ethmoid bone, to which the falx cerebri is attached.

Crura Cerebelli. Two white cords, extending one along the circumference of each hemisphere of the cerebellum.

Crura Cerebri. Two thick, white fasciculi, one from the inferior surface of each hemisphere of the cerebrum.

Dartos. The second or subcutaneous layer in the scrotum, consisting of involuntary muscular tissue.

Decussate. Applied to nerves or muscular fibres that cross each other.

Defæcation. The evacuation of the fæces or excrementitious part of the food.

Deglutition. The act of swallowing.

Dentin. The bone-like substance composing the inner part of the body, neck, and roots of the teeth.

Diploe. The cancellated substance between the two tables in the bones of the skull.

Ductus Arteriosus. A blood vessel peculiar to the fœtus, communicating from the pulmonary artery directly to the aorta.

Ductus Venosus. A blood vessel peculiar to the fœtus, communicating from the vena cava ascendens to the vena portæ.

Emphysema. A collection of air in the cellular texture under the skin or beneath the pleural and inter-lobicular areolar tissue of the lungs.

Emulgent. Straining through; applied to the vessels of the kidneys.

Enamel. The hard, compact, white substance investing the crown of the teeth.

Epididymis. An oblong substance formed by numerous convolutions of the vas deferens, attached to the testicle by vessels.

Epiphysis. The extremities of a long bone.

Epithelium. The cuticle covering the mucous membrane.

Erectile Tissue. A peculiar tissue susceptible of erection or rapid turgescence by an increased flow of blood.

Eustachian Tube. The canal connecting the cavity of the tympanum to the mouth.

Fallopian Tubes. Two canals lying in the folds of the broad ligaments of the uterus, for the transmission of the ovum from the ovary to the uterus.

Fascia. The tendinous expansion over the muscles of a limb.

Fascia Lata. A tendinous expansion continued from the glutei and neighbouring muscles, which maintains the various muscles of the thigh in their position.

Fauces. The cavity at the back of the mouth from which the pharynx and larynx proceed.

Fibrin. A peculiar whitish solid, insipid and inodorous compound substance found in animal and vegetable matter; coagutable lymph.

Foramen. A hole or opening.

Fornix. An arch across the centre of the brain.

Fossa. A depression, little pit or sinus.

Ganglion. An enlargement in the course of the nerve, resembling a knot.

Gland. An organ consisting of blood-vessels, absorbents, and nerves for secreting or separating some particular fluid from the blood.

Glisson, Capsule of. A thin, strong sheath of peritoneum, which surrounds the vessels of the liver which enter or leave the transverse fissure throughout the entire organ.

Hippocampus Major. A large white substance in the inferior cornu of the lateral ventricles of the brain.

Hippocampus Minor. A small eminence of white substance in the posterior cornu of the lateral ventricles of the brain.

Hyaloid Membrane. An extremely delicate membrane of the eye, whose numerous cells contain the vitreous humour.

Ilio-Cœcal Valve. The inferior semi-lunar fold of mucous membrane, which prevents any matter re-entering the ilium from the cœcum.

Infundibulum. A term applied to three small tubes in the kidney, of a funnel-like shape; also to a canal leading from the third ventricle of the brain to the pituitary gland.

Iris. A delicate circular membrane of the eye, floating in the aqueous humour, suspended vertically behind the cornea, and perforated to form the pupil.

Lamina. Any thin layer of bone, membrane, or other substance.

Larynx. The upper part of the windpipe.

Levator. An elevator or lifter-up; applied to muscles.

Linea Alba. The central tendinous line from the ensiform cartilage to the pubis.

Liquor Amnii. The fluid in which the fœtus floats.

Mastication. The act or process of chewing.

Medulla Oblongata. That part of the spinal cord or marrow that joins the brain.

Medulla Spinalis. The spinal marrow or spinal cord.

Mitral Valves. Applied to the left auriculo-ventricular valves from their shape.

Muscle. A distinct portion of flesh, susceptible of contraction and relaxation, by which motion and action (voluntary, involuntary, and mixed) are performed.

Nares. The nostrils.

Normal. In a state of health and proper function.

Omentum. The caul. A duplicature of the peritoneum.

Ovarium. The ovary, an oval body connected with the uterus by the broad ligament, one on each side, containing a number of vesicles or ova.

Papilla. A conical eminence.

Pepsin. The active principle of the gastric juice.

Peristaltic. Applied to the peculiar movement of the intestines, like that of a worm in its progress, hence also named vermicular motion.

Pes anserinus. The distribution of the facial nerve.

Petit, Canal of. A small triangular canal between the layers of the hyaloid membrane that encloses the crystalline lens.

Peyer's Glands or **Patches.** Assemblages of minute glands on the internal surface of the intestines. First noticed by Peyer.

Phalanges. Applied to the bones of the coronet and foot.

Pharynx. The musculo-membranous bag at the back of the mouth and upper part of the œsophagus.

Placenta. A vascular mass by which the connection is maintained between the fœtus and mother.

Pneumogastric Nerve. A part of the eighth pair which supplies the lung and stomach.

Pulmonary Plexus. The bronchial plexus of nerves formed at the back of the bronchia by the par vagum and great sympathetic nerves.

Pupil. The round, black, or dark opening in the centre of the iris.

Pylorus. The opening between the stomach and duodenum.

Raphe. An apparent ridge or suture, as if the parts had been stitched together.

Reflex Action. The act whereby an impression, being conveyed by a sensitive nerve to the nervous centre, the impulse of motion is conveyed to certain muscles by a motor nerve without the will of the individual.

Renal. Belonging to the kidney.

Respiration. The function of breathing, including both inspiration and expiration.

Retina. The nervous coat of the eye.

Saliva. Spittle. The fluid which mixés with the food during mastication.

Sanguification. The natural function by which the blood is formed from the chyle.

Semicircular Canals. Three canals, their form indicated by their name, in the petrous portion of the temporal bone, and opening into the vestibulum.

Septum. A partition; applied to bones, cartilages, membranes, &c.

Serratus. Toothed like a saw; serrated.

Serum. The yellow fluid which separates from the blood when cold and at rest.

Schneiderian Membrane. The mucous membrane lining the nose.

Sinus. A cavity, hollow, or depression.

Skin. Is composed of three membranes. The outermost is the scarf-skin, cuticle or epidermis; the middle, the rete-mucosum; and the innermost, the true skin, cutis vera or derma.

Spermatozoa. Floating cells in animal semen, supposed to be distinct animals.

Sphincter. A circular muscle which contracts round the aperture to which it is attached.

Spinal Cord. The spinal marrow or medullary substance contained in the spinal or vertebral column.

Sutura. The union of flat bones by their margins.

Symphysis. The natural union of bones by means of an intervening substance.

Syndesmosis. Union of bones by ligament, as the radius and ulna.

Synovia. The unctuous fluid secretion of certain glands in the joints, with which the cartilaginous surfaces of the articulating heads of bones are lubricated and their motions facilitated.

Tentorium. The horizontal process of the dura mater, between the cerebrum and cerebellum.

Theca. The investing membranous covering or sheath of the spinal cord and nerves.

Tricuspid. Having three points. Applied to the right auriculo-ventricular valve of the heart.

Trochanter. The name of the two bony prominences on the upper end of the femur.

Turbinated. Formed like a top, broad above and small downwards.

Tympanum. The drum, or hollow part of the middle ear.

Urachus. The tube which connects the bladder and allantois in fœtal life.

Ureter. The tube through which the urine is conveyed from the kidney to the urinary bladder.

Uvea. The posterior surface of the iris of the eye.

Vas Deferens. The duct conveying the semen secreted in the testicle.

Vascularity. The state of having numerous, or being full of, little vessels.

Vesicula. Applied to certain little receptacles.

Villi. Projections from the surface of mucous membrane, having the appearance of the pile of velvet.

Vitreous Humour. A perfectly transparent fluid enclosed in the cells of the hyaloid membrane.

Willis, Circle of. A remarkable arterial junction on the base of the brain.

Xiphoid Cartilage. The cartilage at the extremity of the sternum. The ensiform cartilage.

Zygoma. A bony arch, uniting the malar and temporal bones.

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ERRATA.

Page 17.—Lines 5, 8, *for* odentoid *read* odontoid.
„ 47.— „ 2, 4, 22, 24, *for* interosseus *read* interosseous.
„ 64.—Line 9, *for* accelator *read* accelerator.
„ 75.— „ 13, *for* alaque *read* alæque.
„ 79.— „ 23, *for* stylo-hyodius *read* stylo-hyoideus.
„ 120.— „ 27, *for* cœlic *read* cœliac.
„ 151.— „ 19, *for* corda *read* chorda.
„ 163.— „ 31, *for* raphæ *read* raphé.
„ 165.— „ 4, *for* crustra *read* crusta.
„ 169.—Lines 25, 33, *for* ilium *read* ileum.
„ 171.—Line 22, *for* ilium *read* ileum.
„ 187.— „ 13, *for* raphæ read raphé.

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